BPP VINH CHAU WIND POWER LIMITED LIABILITY COMPANY

ENVIRONMENTAL IMPACT ASSESSMENT

PROJECT

WIND POWER PLANT NO 3

Location: Vinh Chau Town – Soc Trang Province

(The report has been revised and supplemented according to the opinion of the Council of appraisal of environmental impact assessment reports of the Department of Natural Resources and Environment in Soc Trang province.

meeting on April 25, 2019)

Soc Trang, March 2019

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PROJECT OWNER
BPP VINH CHAU WIND POWER LIMITED LIABILITY COMPANY

CONSULTING AGENCY
POWER ENGINEERING AND CONSULTING JOINT STOCK COMPANY NO.3

Soc Trang, March 2019

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LIST OF ABBREVIATIONS

APH	:	Air preheater
BOD	:	Biochemical Oxygen Demand
COD	:	Chemical Oxygen Demand
DO	:	Diesel oil
DONRE	:	Department of Natural Resources and Environment
EIA	:	Environmental impact assessment
EPA	:	United States Environmental Protection Agency
EVN	:	Viet Nam Electricity
FS	:	Feasibility Study
PECC3	:	Power Engineering & Consulting Joint-Stock Company No.3
PAH	:	Project affected household
SS	:	Substation
TDS	:	Total dissolved solids
T/L	:	Tranmission line
THC	:	Total hydrocarbon
VND	:	Vietnamese Dong
VOC	:	Volatile organic compounds
WHO	:	World Health Organization
WPP	:	Wind Power Plant

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INTRODUCTION

1 BACKGROUND

1.1 Project base Summary

In the present situation and in the near future, the country's electricity demand has been growing at high rate, whereas the power sources have been developed slowly so they cannot meet this demand and there is no spare power source. Wind power is a clean energy source and more useful. The cost of wind power is stable and not affected by volatility of fossil fuels. Wind power helps create jobs to increase income in areas having wind power plants. Because wind is inexhaustible energy source, wind power contributes to energy security whereas fossil fuels are non-renewable energy.

According to the plan of wind power development in Soc Trang province in the period from 2020 to 2030, approved by the Ministry of Industry and Trade, according to this project, the area of Vinh Chau town has wind potential of about 6 m / s at an altitude of 80m .

Soc Trang is one of the richest wind resources in Vietnam, so construction of a wind power plant in Soc Trang will bring the highest efficiency compared with other locations. Based on the color code map of wind energy density class in Vietnam at 65m elevation of World Bank, the location for construction of the wind farm is in communes of Bac Son, Bac Phong (Vinh Phuoc town), Tan Hai, and Phuong Hai (Ninh Hai district) Soc Trang province, the area possesses high potential of wind energy.

With the above characteristics, the Investment project "Wind Power Plant No 3" which is invested by BPP Vinh Chau Wind Power Limited Liability Company as a generating source linked to the national grid system is reasonable to provide additional power for Soc Trang province in particular and Vietnam in general.

This is a project using renewable and clean energy, which does not cause emissions of greenhouse gases and be exploited in areas having strong wind energy potential. This project has high feasibility, promotes socio-economic development for the area. Measuring wind and survey the project area to make the Investment project was allowed by the PC of Soc Trang province according to document No. 1040/QĐ-UBND on May 04th, 2018, No. 2571/QĐ-UBND on October 02nd, 2018 and No. 502/QĐ-UBND on February 27th, 2019.

Based on Law of Environmental Protection according to Decree No.18/2015/ND-CP on February 14th, 2015 of the Government on Environmental protection planning, Strategic environmental assessment,

Environmental Impact Assessment and Environmental Protection Plans, the project of Wind Power Plant No 3 has got 110kV transmission line so it belongs to group which has to make EIA report and be submitted to the PC of Soc Trang province for appraisal and approval.

1.2 Authorized agencies and organizations for approval of the Investment project

BPP Vinh Chau Wind Power Limited Liability Company is responsible for consideration and approval of the Investment project of "Wind Power Plant No 3".

1.3 Relation between the project and the Master Development Plan

Implementation of this project is entirely consistent with the approval of power development plan of Soc Trang province in period 2016 - 2025 with vision to 2035 was approved in Decision No. 2630/QĐ-BCT on July 27th, 2018 by the Ministry of Industry and Trade and wind power development plan of Soc Trang province to 2020 with vision to 2030 was approved in Decision No. 3909/QĐ-BCT on May 06th, 2014 by the Ministry of Industry and Trade, Decision No. 423 / QD-TTg on April 11, 2012 of the Prime Minister on approving the Socio-Economic Development Master Plan for Soc Trang Province to 2020;

2 LEGAL BASIS AND TECHNIQUE OF EIA IMPLEMENTATION

2.1 Legal basis and technical documents

- Environmental Protection Law of the Socialist Republic of Vietnam No.55/2014/QH13 on June 23rd, 2014 was passed by the National Assembly;
- Construction Law No. 55/2014/QH13 on June 18th, 2014 approved by the National Assembly of the Socialist Republic of Vietnam;
- Water Resources Law of the Socialist Republic of Vietnam No.17/2012/QH13 on June 21st, 2012 was passed by the National Assembly;
- Electricity Law No. 28/2004/QH11 was approved on December 03rd, 2004 by the National Assembly of the Socialist Republic of Vietnam;
- Law No.24/2012/QH13 on amending and supplementing a number of articles of the Electricity Law was approved by the National Assembly of the Socialist Republic of Vietnam on November 20th, 2012;
- Amended Land Law No.45/2013/QH13 was passed by the National Assembly of the Socialist Republic of Vietnam on November 29th, 2013;
- Decree No.18/2015/ND-CP on February 14th, 2015 of the Government on Environmental protection planning, Strategic environmental assessment, Environmental Impact Assessment and Environmental Protection Plans;

- Decree No.38/2015/ND-CP on April 24th, 2015 of the Government on Management of Waste and Discarded materials.
- Decree No.137/2013/ND-CP on October 21st, 2013 of the Government on Detailing implementation of a number of articles of the electricity law and the law on amending and supplementing a number of articles of the electricity law
- Decree No.155/2016/ND-CP on November 18th, 2016 of the Government on Penalties for administrative violations against regulations on Environmental protection.
- Decree No.14/2014/ND-CP on February 26th, 2014 of the Government on Stipulating in detail the implementation of electricity law regarding electricity safety.
- Decree No.44/2014/ND-CP on May 15th, 2014 of the Government on Regulations on land prices.
- Decree No.46/2015/ND-CP on May 12th, 2015 of the Government on Quality control and maintenance of construction works.
- Decree No.47/2014/ND-CP on May 15th, 2014 of the Government on Regulations on compensation, support, and resettlement upon land expropriation by the state.
- Circular No.31/2014/TT-BCT on October 2nd, 2014 of the Ministry Of Industry And Trade on Stipulating certain details of electrical safety.
- Circular No.36/2015/TT-BTNMT on June 30th, 2014 of the Ministry Of Natural Resources And Environment on Management of hazardous wastes.
- Circular No.27/2015/TT-BTNMT on May 29th, 2015 of the Ministry Of Natural Resources And Environment on Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Plans.
- Circular No.24/2016/TT-BYT on June 30th, 2016 of the Ministry Of Health on National technical regulation on noise - permissible exposure levels of noise in the workplace.
- Circular No. 46/2015 / TT-BGTVT on September 7, 2015 of the Ministry of Transport regulating the load, limiting size of roads, circulation of overloaded vehicles, oversized vehicles, tracked vehicles on the road, transporting super-sized and super-weight cargoes, limiting cargo loading on road transport when participating in traffic on roads.
- Circular No. 02/2019 / TT-BCT on January 15, 2019 of the Ministry of Industry and Trade regulating the implementation of wind power project

development and sample power purchase contracts for wind power projects.

- Decision No.12/2008/QD-BCT on June 17th, 2008 of the Ministry of Industry And Trade to Promulgate the national technical regulation on electrical safety.
- Directive No. 04 / CT-UBND on 10 April 2018 of the Chairman of the Provincial People's Committee on strengthening management of activities of exploiting land for common construction materials in Soc Trang province.
- Decision No. 34/2014 / QD-UBND dated December 31, 2014 of Soc Trang Provincial People's Committee on promulgating regulations on a number of compensation, support and resettlement policies when the State acquires land on the land table of Soc Trang province;
- Decision No. 09/2017 / QD-UBND dated February 22, 2017 of the People's Committee of Soc Trang Province on promulgating regulations on density, norms, compensation unit prices, support for crops, crops and animals Aquaculture is a fishery in Soc Trang province.

2.2 Related legal document

- Decision No. 423/QD-TTg dated April 11st, 2012 by the Prime Minister on approving the development Master Plan for Socio-Economic in Soc Trang Province up to 2020;
- Decision No. 3909/QD-BCT dated May 06th, 2014 by the Ministry of Industry and Trade on the development of wind power in Soc Trang province up to 2020 with a vision to 2030;
- Decision No. 2630/QD-BCT dated July 27th, 2018 by the Ministry of Industry and Trade on the electricity development planning of Soc Trang province in period 2016 - 2025 with vision to 2035;
- Decision of Investment Policy No. 1040 / QD-UBND on May 4, 2018 of Soc Trang People's Committee;
- Decision No. 2571 / QD-UBND on October 2, 2018 of the People's Committee of Soc Trang Province on adjusting the decision of the investment policy of the Investment Project on Construction of Wind Power Plant No. 3 in Soc Trang Province of Banpu Power Public Company;
- Decision No. 502 / QD-UBND on February 27, 2019 of the People's Committee of Soc Trang Province adjusting the decision of the investment policy of the Investment Project of Building Wind Power Plant No. 3 in Soc Trang Province of BRE Singapore PTE.LTD Company;
- Investment certificate on May 21, 2018 by DPI to Banpu Power Public

Company;

- Business registration certificate on January 22, 2019 by DPI for Vinh Chau Wind Power BPP Co., Ltd.
- Document No. 573 / SCT-QLNL dated 17/6/2019 of Soc Trang Department of Industry and Trade v / Notice of appraisal results of the basic design of the investment project for construction of No. 3 wind power plant in Soc Trang

2.3 Standards and regulations applied

- QCVN 03-MT:2015/BTNMT – National Technical Regulation on permissible limits of heavy metals in soil;
- QCVN 05:2013/BTNMT – National Technical Regulation on Ambient Air Quality;
- QCVN 08-MT:2015/BTNMT – National technical regulation on surface-water quality;
- QCVN 14:2008/BTNMT – National technical regulation on domestic wastewater;
- QCVN 07:2009/BTNMT – National Technical Regulation on Hazardous Waste Thresholds;
- QCVN 19:2009/BTNMT – National Technical Regulation on Industrial Emission of Inorganic Substances and Dusts;
- QCVN 24:2016/BYT – National Technical Regulation on noise - permissible exposure levels of noise in the workplace;
- QCVN 26:2010/BTNMT – National Technical Regulation on noise;
- QCVN 27:2016/BYT – National Technical Regulation on vibration - permissible levels of vibration in the workplace;
- QCVN 40:2011/BTNMT – National Technical Regulation on Industrial Wastewater.
- QCVN 25: 2016 / BYT - National Technical Regulation on industrial frequency electromagnetic field - exposure level allowing industrial frequency electromagnetic field at work place.

2.4 Data source established by the project owner

- Report of Topographic survey project of Wind Power Plant No 3 was established by PECC3 in December 2018;
- Report of the Investment project of Wind Power Plant No 3 was established by PECC3 in March 2019;

- Report of Basic Design of Wind Power Plant No 3 was established by PECC3 in March 2019.

3 ORGANIZATIONS OF EIA IMPLEMENTATION

Project owner: BPP Vinh Chau Wind Power Limited Liability Company (Chairman: Mrs. Bubpachart Meecharoen, address: 22 Bui Thi Xuan St, ward 2, Soc Trang city, Soc Trang province).

Consulting agency: Power Engineering and Consulting Joint Stock Company No.3 (PECC3) (General Director: Mr. Thai Tuan Tai, address: 32 Ngo Thoi Nhiem St., District 3, HCM city, Tel: 028.2221.1125, Fax: 028.3930.7938 - Environment Department).

Members directly involved in the EIA report:

No.	Name	Major	Company	Task	Signature
Project owner					
1	Apisara Sukdang		BBP VC		
Consulting agency					
1	Ho Huu Hung				
2	Do Trung Kien	Master of Environment	Head of Environment division	Synthesis report	
3	Nguyen Thai Vu	Environmental engineer	Deputy of environment division	Compensation, resettlement plan	
4	Nguyen Minh Hieu	Environmental engineer	Staff	Support survey, investigation, statistical data. Preparing an environmental impact assessment report.	
5	Le Thi Ngoc Xuan	Environmental engineer	Staff	Support survey, investigation, statistical data.	
6	Tran Thai Son	Environmental engineer	Staff	Support survey, investigation, statistical data.	
7	Do Ngoc Anh Dung	Environmental engineer	Staff	Support survey, investigation, statistical data.	
8	Tran Trung Hieu	Environmental engineer	Staff	Support survey, investigation, statistical data.	

4 APPLIED METHODS IN EIA PROCESS

The implementation content and steps in this EIA report in compliance with the guidance of the Government's Decree No. 18/2015/ND-CP on February 14th, 2011 and Circular No. 27/2015/TT-BTNMT on May 29th, 2011 of the Ministry of Natural Resources and Environment.

Research on environmental impact assessment of the project based on the following methods:

4.1 Methods for EIA

- *Method of making list*

This method is based on tabulation showing relationship between activities of the project with the environmental parameters likely affected by the project to identify environmental impacts.

- *Matrix method*

Matrix method is development of list application. Matrix table is also based on the similar basic principles that is a comparison between every project activity and every parameter or environmental component to evaluate the relationship between" cause and result" in a higher quantitative level compared with evaluation of impact based on the score scale. Total scores reflect the environment components or any environmental parameters most strongly affected by the project.

- *Method using experience of specialist and forecast*

Even though the project has not been built and put into operation but some impacts can be predicted based on the similar projects, learning from actual experiences and calculations with consultancy of specialists. From the prediction results, these impacts can be classified and appropriate mitigation measures can be proposed.

- *Method map*

Using maps to determine location, scope and level of influence of the project.

4.2 Other methods

- *Statistical and data processing Method*

Using statistical method in the collection and processing of observation data on natural conditions, data of sociological investigation in interviewing process of local authorities and people.

- *Method of field sampling and laboratory analysis*

In order to determine parameters of the current state of air quality, water, noise levels in the project area and surrounding areas.

- *Method of rapid assessment*

The report uses a rapid assessment method to identify quickly amount of pollutants, concentration of pollutants in exhaust gas, wastewater, noise level, vibrations arising from the project activities. Calculating pollutant amount in the report is based on the pollution coefficient, specifically using pollution coefficient established by World Health Organization (WHO) and the United States Environmental Protection Agency (USEPA).

- *Modeling method*

This method uses mathematical equations to simulate the distribution of electromagnetic field intensity above ground 1m of the 110kV transmission line to the surrounding environment.

CHAPTER 1
PROJECT DESCRIPTION

1.1 Project name

WIND POWER PLANT NO 3

1.2 Project owner

Project owner : BRE Singapore PTE.Ltd Company

Project implementation company : BPP Vinh Chau Wind Power Limited Liability Company

Chairman : Mrs. Bubpachart Meecharoen

Address : 22 Bui Thi Xuan St, ward 2, Soc Trang city, Soc Trang province

Tel: - Mr. Sittirat Chaimongkol (Director) - Tel: +66 2 694 6600
- BRE Singapore Office Pte.Ltd - Tel: +65 6338 1888

(Phone number of Abogado Pte. Ltd - BRE Singapore Pte.Ltd's secretary company)

1.3 Project location

According to Appendix 2 of Decision No. 3909 / QD-BCT dated May 6, 2014 of the Ministry of Industry and Trade approving the "Planning on wind power development in Soc Trang Province in the period of 2020, vision to 2030", The project is located at No. 3.

The location for construction of Wind Power Plant No 3 is in Vinh Phuoc ward and ward 1, Vinh Chau town, Soc Trang province.

The land use area with a definite term of the project is 10.22ha; temporary use area is 1.345ha.

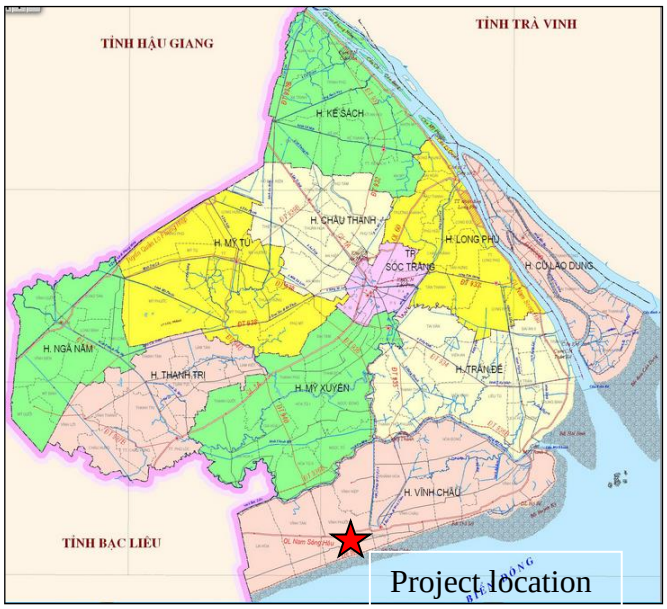


Figure 1.1. Project location on cadastral Soc Trang

1.3.1 *Location of Wind Power Plant No. 3*

Location of Wind Power Plant No. 3 was implemented in Vinh Phuoc Ward, Ward 1, Vinh Chau Town, Soc Trang Province, which has good wind potential in the Western region of Viet Nam. The survey area is ~ 600ha, with the following geographical location:

- The North borders on the asphalt road of the commune and Nam Song Hau road.
- The West borders on the aquaculture area.
- The East borders on the aquaculture area.
- South borders on the East Sea.

The survey boundary of the project after adjusting according to the document No. 573 / SCT-QLNL dated June 17, 2019 of the Department of Industry and Trade informing the results of basic design evaluation of the Plant construction investment project Wind power No. 3 and Document No. 786 / BCH-PTM dated May 31, 2019 by the Military Command of Soc Trang Province on appraisal of design documents of the 3rd National Energy Project (adjusted to M3, coordinates VN2000 zone 6O: 1028177-551968 on point M3.1) new boundary is M2.1, M7, M6, M3.1, M4, M5, after subtracting the overlapping area of land used for remaining Defense 384ha. (For details see the general project drawing attached in Appendix II).

1.3.1.1 Turbine

The location for construction of the wind farm is in Vinh Phuoc ward, Vinh Chau town, Soc Trang province, the area possesses high potential of wind energy.

Wind farm locates in relatively flat terrain between two mountain ranges, and local plantation is mainly seasonal crops. This terrain is advantageous for heavy equipment transport, besides transmission as well as substation 110kV nearby is convenient for grid connection.

List of Coordinates of turbine locations in VN2000 Coordinate system, meridian center: 105°30, projection zone: 3°.

Table 1.1. Turbine coordinate of project

No	Symbols	Categories	Coordinate	
			X (m)	Y (m)
01	WTG01	Turbine 1	1028184,53	547971,29
02	WTG02	Turbine 2	1028485,74	549225,03
03	WTG03	Turbine 3	1028735,04	550362,20
04	WTG04	Turbine 4	1028988,69	551635,62
05	WTG05	Turbine 5	1027916,79	548645,32
06	WTG06	Turbine 6	1028225,02	549892,19
07	WTG07	Turbine 7	1028567,92	551052,12

(Sources: Feasibility Study, PECC3, tháng 03/2019)

In addition, the project does not need to rent land from households for temporary storage, the contractor will take advantage of the sites under the foot of the turbine to make a temporary dump during construction.

Project location is displayed on the Soc Trang province's cadastral map:

1.3.1.2 110kV Wind Power Plant No. 3 substation and expanding 110kV Vinh Chau outgoing feeder

a. Wind Power Plant No. 3 110kV substation

- 110kV Substation of wind power plant No.3 hold at a land of wind power plant No.3 project, belong Vinh Phuoc ward, Vinh Chau town, Soc Trang province.
  + Total area to working : 4.884,8 m^2;
  + Earth area use working substation : 3.744 m^2;
  + Earth area use working external road substation : 1.140,8 m^2;
  + Substation area inside the fence : 3.500 m^2;

- The plant of the ground propose build substation is shrimp pond, have lower slope, basic is clay gray brown in condition plastic flow. Natural altitude of ground propose build substation modify about +0.40m to +0.75m (survey altitude is national altitude). Base substation to flatten. Design level of earth base substation is +2.85m (survey altitude is VN2000 altitude).

b. Expanding 110kV Vinh Chau outgoing feeder

- Expanding 110kV outgoing feeder of 110kV Vinh Chau substation, belong Vinh Chau town, Soc Trang province.

  + Total area to working : 2.000,7 m^2;

  + Earth area use working substation : 2.000,7 m^2;

  + Substation area inside the fence : 1.672 m^2;

- The plant of the ground propose build expanding 110kV outgoing feeder is shrimp pond, have lower slope, basic is clay gray brown in condition plastic flow. Natural altitude of ground propose build substation modify about -0,40m to +0,2m (survey altitude is national altitude). Base substation to flatten. Design level of earth base substation is +1,85m (survey altitude is VN2000 altitude).

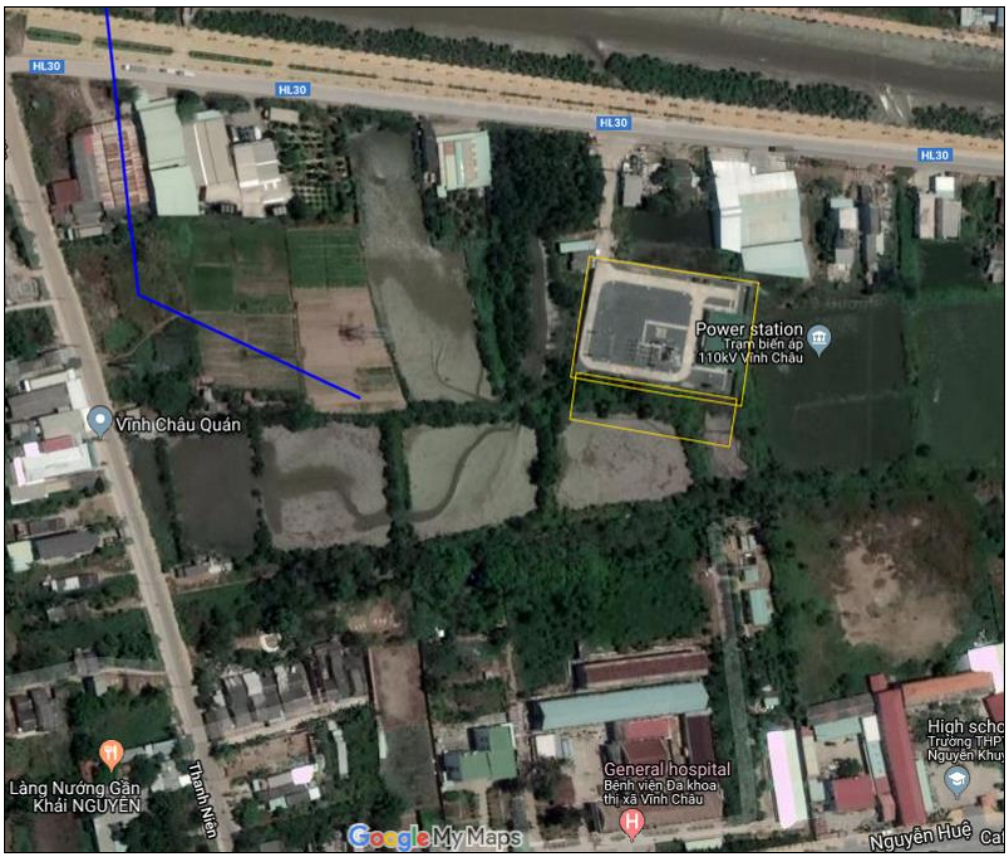


Figure 1.2. Expanding 110kV Vinh Chau outgoing feeder

1.3.2 Internal road system

The project to build internal roads to build and operate the factory with a total length of 5,716km. Roads connected to a wide road platform turbine shaft are 6.5m; each side of the ground is 0.5m wide and the slope of 1: 1.5 is used to transport equipment.

The entire internal road is built within the two wards of the project, not built outside the scope of the project approved by the PPC.

1.3.3 110kV transmission line Wind Power Plant No 3 – Vinh Chau

The location for 110kV tranmission line Wind Power Plant No 3 – Vinh Chau is in Vinh Phuoc Ward and Ward 1, Vinh Chau town, Soc Trang province.

+ Start point : 110kV busbar of 22/110kV Wind Power Plant No.3 SS (new contruction).
+ End point : 110kV (extended) of 110kV Vinh Chau SS (existing).
+ Voltage : 110kV.
+ No. of circuits : 02 circuits (early statge with 01 circuit wired).
+ Route lenght : : 5.8km.

Table 1.2. List of coordinates of 110kV substation in VN2000 Coordinate system – Vinh Chau

No.	Symbol	X (m)	Y (m)
1	ĐĐ	1028772,17	549491,52
2	G1	1028948,96	549395,90
3	G2	1029548,64	549267,69
4	G3	1030297,22	548914,97
5	G4	1030875,94	548913,66
6	G5	1031582,94	550559,80
7	G6	1031634,16	551743,91
8	G7	1031296,36	551782,51
9	ĐC	1031314,19	551912,81

Source: Feasibility Study, PECC3, March 2019

Table 1.3. Length of the route through the locality

No.	Name of route	Length of route (m)	Name of local
1	ĐĐ ÷ G5	4,012.21	Vinh Phuoc ward - Vinh Chau - Soc Trang
2	G5 ÷ G6	842.7	Vinh Phuoc ward - Vinh Chau - Soc Trang
		342.52	ward 1 - Vinh Chau - Soc Trang
3	G6 ÷ ĐC	605.27	ward 1 - Vinh Chau - Soc Trang
	Total	**5.802,70**	

Figure 1.3. Project general layout

Figure 1.4. Satellite image of wind farm area

1.3.4 Around the project

1.3.4.1 Natural objects around the project

- Road transport system: development of transport system, there are 3 main transport systems.
- Water, canal and pond transportation system: in the project area, there is no big river system, mostly agricultural ponds of local people, the South is adjacent to the East Sea.
- From the No. 1 turbine tower and the turbine head No. 02 about 1,000 meters to the south of the sea dike, 800m to the south from the sea dike protection corridor, 1,050 to the south of the protection forest.
- From the turbine tower No. 03 and No. 04 turbine tower about 800m south of the sea dike, 600m from the sea dike protection corridor to the south, 850 from the protection forest to the south.
- From the turbine tower No. 05 about 600m from the sea dike to the south, 400m from the sea dike protection corridor to the south, 650 to the south of the protection forest.
- From No. 06 and turbine turbine No. 07 from the sea dyke about 500m to the south, 300m from the sea dike protection corridor to the south, 550m from the protection forest to the south.

1.3.4.2 Socio-economic objects around the project

- Turbine 1, 2, 3, 4, 5, 6, 7 is about 1km from Vinh Phuoc Ward People's Committee to the North;
- Turbine 1, 2, 3, 4, 5, 6, 7 is about 4.1 km from People's Committee of Ward 1 to the East;
- Turbine 1, 2, 3, 4, 5, 6, 7 are about 30.5 km north of Doi pagoda;
- The project goes through and lies on the aquaculture land of households;
- The project area is mainly the guardhouse of households, the position of the No. 2 turbine head is 500m to the north of the nearest house.

1.3.5 Status of management and use of land on the project land area

According to the field survey conducted by PECC3 in November 2018- March 2019, the land located in the corridor is mainly aquaculture land, annual crop land, land for perennial crops, ...

Details of the current status of land use on the permanent occupied area of the Project are listed in Table 1.4 below:

Table 1.4. Length of the route through the locality

TT	Categories	Status of land use	Status of management
1	Wind power plant		
1.1	Turbine No. 1, 4, 7	Aquaculture land	Land of households
1.2	Turbine No. 2, 3, 5, 6	Aquaculture land	Land of Vinh Thuan Company
2	110Kv Substation No.03	Farming land	Land of households
3	110kV line	Farming land	Land of households
4	Road serving and operating	Aquaculture land	Land of Vinh Thuan Company
5	Expansion to prevent existing Vinh Chau 110kV substation	Farming land	Land of households

1.4 Main contents of the project

1.4.1 Purpose of the Project

Project of "Wind Power Plant No 3" will be built as a generating source and connected to the national grid system with the following purposes:

- Additional sources and links with the national electricity system to supply electricity for regional loads and surrounding areas located in Soc Trang province.
- Reducing the power supply radius of distribution grid, contributing to reducing power and power loss.
- Consistent with the orientation of Electricity Development Planning and Wind Power Development Planning of Soc Trang Province.

1.4.2 Quantities and scale of the project's items

1.4.2.1 Main work items

Main work items of the project include:

➢ Wind Turbines

- Construction of 7 wind turbines, support tower for every wind turbine with a design height of 100m;
- Control room

➢ 110kV substation

- Step-up transformer 22/110kV

➢ 22kV transmission line and 110kV connection line

- 22kV internal power network;

- 110kV connection line

➢ Internal road system to support constructing and operating phase.

➢ Expanding to prevent existing 110kV Vinh Chau substation.

Table 1.5. Main work items of the project

Items	Specification	Quantity
Tower	100m	7 pcs
Wind turbine foundation	Foundation	7 pcs
Wind turbine	4.2MW	7 pcs
Step-up station 22/110kV	40MVA	1 Station
Outgoing feeder 110kV		1 feeder
Control system, communication system and SCADA		1 set
Overhead line 110kV	ACSR-240/39	5.8km
Underground cable 22kV	XLPE150+300	26,961km
22kV line for powering construction	ACX/WBCC-70mm^2	80m
Internal road		5,716km

1.4.2.2 Scale of main items of the project

a. Turbine

In feasibility study, selection of rated power and model aims to serve the technical-economic analysis of project. In the next step of technical design and bidding, wind turbine selection will be reconsidered according to investor's requirements.

a.1. The technical characteristics of wind turbine in feasibility study stage

- Rotor:

+ Hub height : 100 m

+ Diameter : 150 m

+ Swept area : 17671.5 m2

+ Rotating speed : 4.9 →10.4 rpm

+ Number of blades : 3

+ Cut-in speed : 3 m/s

+ Cut-out speed : 24.5 m/s

+ Rated wind speed : 12.0 m/s

+ Cut-out (after 10 minutes) wind speed : 20 m/s

- Generator:

+ Rated power : 4200 kW

+ 3-phase voltage : 720 VAC

+ Frequency : 50 Hz

a.2. Control system

The SCADA system of Wind power plant No. 3 is designed in order to acquire data automatically via establishing control center and RTU or Gateway as well as other appropriate equipment with functions as follow:

- Control WTGs and data acquisition;
- Analyzing and reporting operation events;
- Simple operation and minimize faults for plant as well as grid.
- SCADA system in wind farm, including turbines, step-up substation 0.72/22kV.

The SCADA system includes following functions:

- Recording data of turbines including: pitch control, yaw control, faults, damages, and their operation status, generator, gear box, etc.
- Recording events of turbine: control and fault events, stop/run…
- Access to commands of turbine and control
- Accessible to turbine's parameters and I/O
- Observing velocity, ambient temperature.
- Remote access.
- Technical solution for SCADA system of wind farm (turbines and 0.72/22kV step-up substation
- Wind power plant system is designed as shown below:

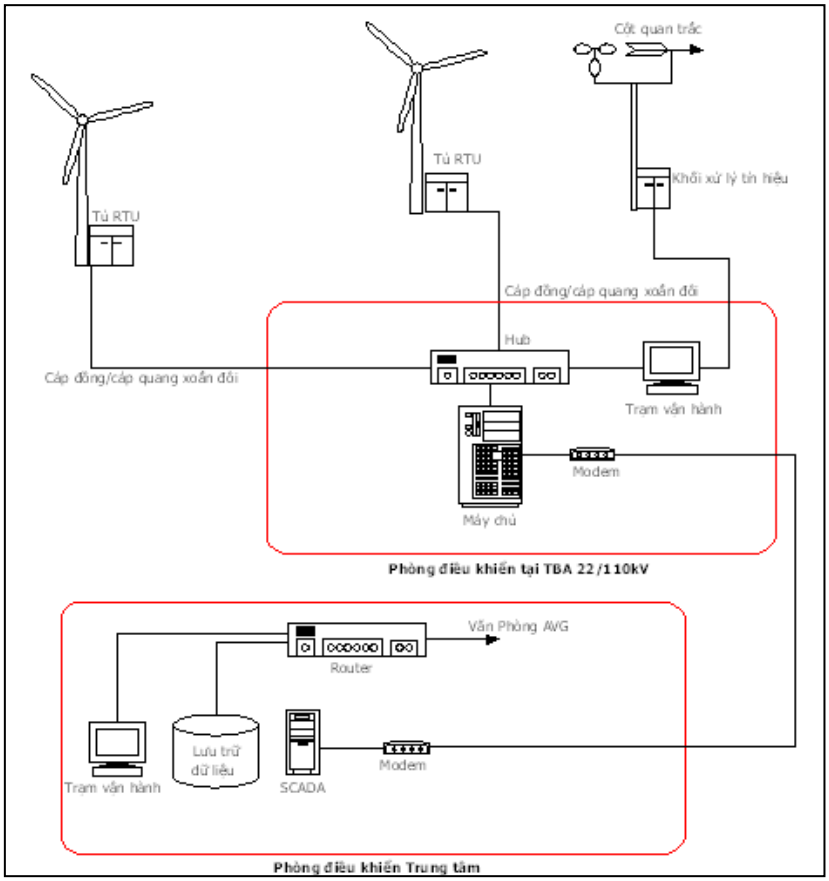


Figure 1.5. Diagram of SCADA system for Wind power plant No. 3

On the turbines, RTU devices (terminal collectors) connect to the turbine controls and communicate with them using control protocols. The RTUs will then connect to the hub device via fiber (or via wireless) and connect to the SCADA control system via the internet. The modem will connect between the wind farm SCADA server and the 22 / 110kV solar-powered transformer substation with the A0 & A2.

- Network communication system in and between Wind turbines.
- System 720V and 22kV.
- The system of individual turbines and groups of turbines in the wind farm.
- Wind data from measurement station.
- Data of substation 22/110kV.
- Tuabine information:
  + Power curve
  + Power curve
  + Motors
  + The generator operates or does not operate.

+ The output power of the generator unit (W/VAr).
+ Frequency (Hz).
+ Current (A).
+ The power output of wind turbines (Wh/VArh).
+ Breaker of the generator (on, off and neutral).

This database is collected by the system on a 10-minute basis. Statistics are aggregated at the end of each day and a daily summary is created and stored for 6 months.

b. 110kV Wind Power Plant No 3 substation

110kV Substation substation No. 3 is built with the following scale:

- Substation : Half outdoor, half-operation by people.
- Voltage : 22/110kV.
- Capacity : 01 transformer 22/110kV-40MVA
- HTPP 110kV : Diagram of 1 bus bar system with segment, in this period, install cutting machine for 01line compartment and 01 transformer compartment. And there is a reserve to improve the busbar system in the future.
- HTPP 22kV : Diagram of a busbar system with segmented, planned to install 08 cabinets in the first stage, including:
  + 01 Outgoing bay breaker cabinet
  + 01 Voltage Transformer cabinet
  + 01 Auxiliary transformer breaker cabinet
  + 04 feeder breaker cabinet
  + 01 segment breaker cabinet

❖ Main electrical connection diagram

- *110kV side:* Using diagram of 1 section bar with section, installing cutting machine for 01 transformer compartment, 01 line compartment. There is a reserve to complete the future busbar into an H-shaped diagram.
- *22kV side:* 22kV distribution system of the station uses a busbar diagram. 22kV side is equipped with 01 outgoing bay cabinet, 01 transformer cabinet, 04 outgoing feeder cabinets 22kV, 01 breaker cabinet for auxiliary transformers and 01 segment cabinet.

❖ Main equipment

- *Transformer 22/110kV*: 3-coil type (including balance roll), 3-phase (50Hz), outdoor installation, voltage 115± 9x1.78% / 23/11kV, with voltage adjustment under 110kV side load Capacity of 40MVA, wiring group YN / yn0 / d-11, method of cooling ONAN / ONAF.
- *22 / 0.4kV transformer*: 2-coil type, 3-phase (50Hz), outdoor installation, voltage 22± 2x2.5% / 0.4kV. Capacity of 160kVA, D / yn wiring group, method of cooling ONAN.

❖ 110kV distribution system

- 110kV switching: outdoor type, 3 phase, SF6 gas insulated, Uđm = 123kV, Iđm = 1250A, Ic nm = 31.5kA / 1s, manipulated by spring-tension motor, 110Vdc operating voltage, afternoon Minimum leakage path length of 31mm / kV.
- 110kV isolation: outdoor, 3 phase, 1 phase; 2-sided grounding, 1 side grounding and no grounding; horizontal opening, center cut; Uđm = 123kV, Iđm = 1250A, Ic is nm = 31,5kA / 1s, the main blade is operated by motor and manual, the earthing tool is operated manually, there is an interlock between the main switch and ground and electric switch 110Vdc operation pressure, leakage path length at least 31mm / kV.
- 110kV current transformer: outdoor, 1 phase, Udm = 123kV, rate 200-400-600 / 1/1/1/1 / 1A, accurate level 5P20 / 0.5 / 0.5 / 5P20 / 5P20, capacity 15/10/10/15 / 15VA, rate 200-300-400 / 1/1/1/1 / 1A, accurate level 5P20 / 0.5 / 0.5 / 5P20 / 5P20, capacity 15/10/10/15 / 15VA, minimum leakage path length of 31mm / kV.
- 110kV type 1 voltage transformer: outdoor type, capacitor type, 1 phase, 123kV, ratio 110:√3/ 0.11:√3/ 0.11/√3/ 0.11/√3 kV, Accurate level 0.5/0.5/3P, level 10/10/25VA, capacity, minimum leakage path length of 31mm / kV.
- 10kV type 2 voltage transformer (busbar): outdoor type, capacitor type, 1 phase, 123kV, ratio 110:√3/ 0.11:√3/ 0.11/√3/ 0.11/√3 kV, accurate level of 0.5 / 0.5 / 3P, 10/10/25VA capacity, minimum leakage length of 31mm / kV.
- Anti-lightning valve 110kV: outdoor type, 1 phase, ZnO, 96kV - 10kA - CL3, minimum leak length of 31mm / kV.
- 10kV side bar: Use busbar Φ100.
- Wire connecting equipment of 110kV highway compartments: Using steel core aluminum wire ACSR-240.

- Vertical insulation: Outdoor, ceramic or polymer, 123kV voltage, leakage path length of at least 31mm / kV.
- Chain insulation: Outdoor, glass or polymer, 123kV voltage, leakage path length of at least 31mm / kV.

❖ **22kV distribution system**

- 22kV breaker cabinet: type of indoor cabinet, 3 phase, vacuum insulation or SF6 included:
  + Outgoing bay : 24kV - 1600A - 25kA/1s.
  + Outgoing feeder : 24kV - 630A - 25kA/1s.
  + LBS cabinet for auxiliary transformer: 24kV - 200A - 25kA/1s.
  + Transformer cabinet : 24kV - 100A/6,3A
- Current transformer 22kV:
  + Outgoing bay: 24kV, ratio 800-1200-1600/1/1/1A, accuracy 0.5/5P20/5P20, capacity 15/15/15VA.
  + Outgoing feeder cabinet: 24kV, ratio 300-600/1-1-1A, accuracy level 0.5/5P20/5P20, capacity 15/15/15VA.
- Busbar voltage transformer 22kV: 3 phases, ratio 22:√3 / 0,11:√3 / 0,11:√3kV, rated capacity 2x30VA, accuracy level CL 0,5/3P.
- Voltage transformer installed in the outgoing bay cabinet 22kV: 3 phase, ratio 22:√3 / 0,11:√3 kV, rated capacity 20VA, accuracy level CL 0,5/3P.
- Voltage transformer installed in the outgoing feeder cabinet 22kV: 3 phase, ratio 22:√3 / 0,11:√3kV, rated capacity 20VA, accuracy level CL 3P.
- Lightning valve 22kV (set on transformer 22/110kV): outdoor type, 1 phase, ZnO, 18kV - 10kA - CL3.

❖ Protection control system

The control system of the station includes the equipment installed on the protective cabinet and measurement for the outgoing feeders to perform the following functions:

- Express the connection of elements with floating diagrams.
- Control switching 110kV, 22kV and 110kV isolation.
- Report the location of breaker, isolation and grounding switch.
- Interlocking of switching control circuits of circuit breakers, isolation and grounding tools in accordance with the design scheme to avoid manipulating the wrong operation to damage the device and the operator.

- Control the 22kV output voltage of the force transformer by the interlock control switch with the auto-tuning circuit.
- Control the fan system of force transformer by control lock with 2 modes manually and automatically.
- The control system is also equipped with sound and light alarms when incident signals appearation and the protection relay system works.
- The system automatically adjusts the voltage under load and cooling fan control system for the transformer.

The protection relay system uses a high-sensitivity, fast-acting digital protection relay, with connection protocol according to IEC 61850, capable of communicating with SCADA system. The system is equipped with the following protective elements:

- Protection of 110kV line compartment included:
  + Protection distance integrated protection functions 87L, 21/21N, 67/67N, 50/51, 50/51N, 50BF, 79/25, 85, FL, FR.
  + Overcurrent ground protection with direction of integrating protection functions 67/67N, 50/51, 50/51N, 27/59, 50BF, 85, FR
  + 02 protective circuit breakers 74 and 02 set of switch relays 86.
- 110kV force transformer protection including:
  + Internal protection transformer: steam protection, oil temperature protection - coil, oil level protection, oil pressure protection.
  + Main protection: deviation protection Integrated transformer protection functions 87T, 49, 64, 50/51, 50 / 51N, 50REF1, 50REF2, FR.
  + 110kV side backup protection: directional overcurrent protection integrates protection functions 67 / 67N, 50/51, 50 / 51N, 27/59, 85, 25, 50BF, FR.
- 22kV side protection including:
  + Protection for the outgoing bay cabinet: overcurrent protection of ground direction with integrated protection functions 67/67N, 50/51, 50/51N, 25, 50BF, 74, 86, 27/59, BCU.
  + Protection for outgoing bay cabinet: ground overcurrent protection of land with the direction of integrating protection functions 67/67N, 50/51, 50/51N, 74, 25/79, 50BF, 81, 86, BCU.
- 22kV busbar protection: low / overvoltage protection (F27 / 59), protection of load shedding by frequency (F81).

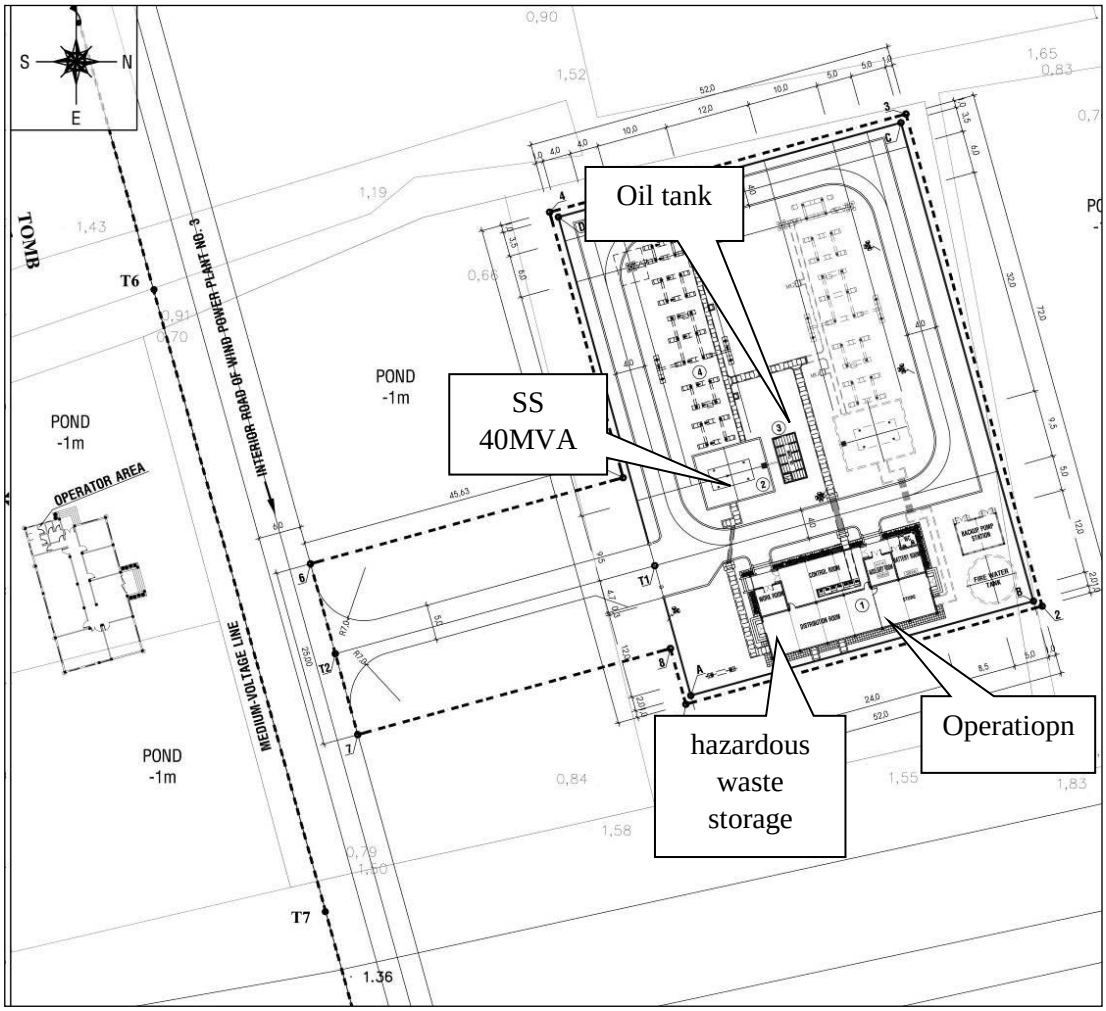


Figure 1.6. 110kV substation wind power plant No 3 layout

c. Expansion of outgoing feeder at existing 110kV Vinh Chau substation

❖ Construction site

The construction of the 110kV line at Vinh Chau station is built on the expanded land from the existing 110kV Vinh Chau substation in Vinh Chau town, Soc Trang province..

❖ Scaled

Installation of complete equipment (breaker, isolation, current transformer) for 01 110kV compartment at Vinh Chau 110kV station according to the existing diagram.

- Diagram of main electrical connection

On 110kV side: Use diagram of 1 busbar in accordance with the existing electrical connection diagram of the existing 110kV Vinh Chau substation.

- The main equipment

110kV distribution system

- 110kV breaker: outdoor type, 3 phase, SF6 gas insulated, Uđm = 123kV, Iđm = 1250A, Ic nm = 31.5kA / 1s, manipulated by spring-tension motor, 110Vdc operating voltage, minimum leakage path length of 31mm / kV.
- 110kV isolation: outdoor, 3 phase, 1 phase; 2-way grounding, 1 side grounding; horizontal opening, center cut; Uđm = 123kV, Iđm = 1250A, Ic is nm = 31,5kA / 1s, the main blade is operated by motor and manually, the earthing tool is operated manually, there is an interlock between the main switch and ground and 110Vdc voltage, leakage path length at least 31mm / kV.
- 110kV current transformer: outdoor, 1 phase, Udm = 123kV, rate 200-400-600 / 1/1/1/1 / 1A, accuracy level 5P20 / 0.2 / 0.5 / 5P20 / 5P20, capacity of 15/10/10/15 / 15VA, minimum leakage path length of 31mm / kV.
- 110kV type 1 voltage transformer: outdoor type, capacitor type, 1 phase, 123kV, ratio 110:√3/ 0,11:√3/ 0,11/√3/ 0,11/√3 kV, accuracy level 0,2/0,5/3P, capacity 10/10/25VA, minimum leakage length of 31mm / kV.
- 110kV side bar: Use the tube basbar Φ80.
- Wire connecting equipment of 110kV highway compartments: Using steel core aluminum wire ACSR-400.
- Vertical insulation: Outdoor, ceramic or polymer, 123kV voltage, leakage path length of at least 31mm / kV.

❖ Chain insulation: Outdoor type, made of glass or polymer, 123kV voltage, minimum leakage path length of at least 31mm / kV.

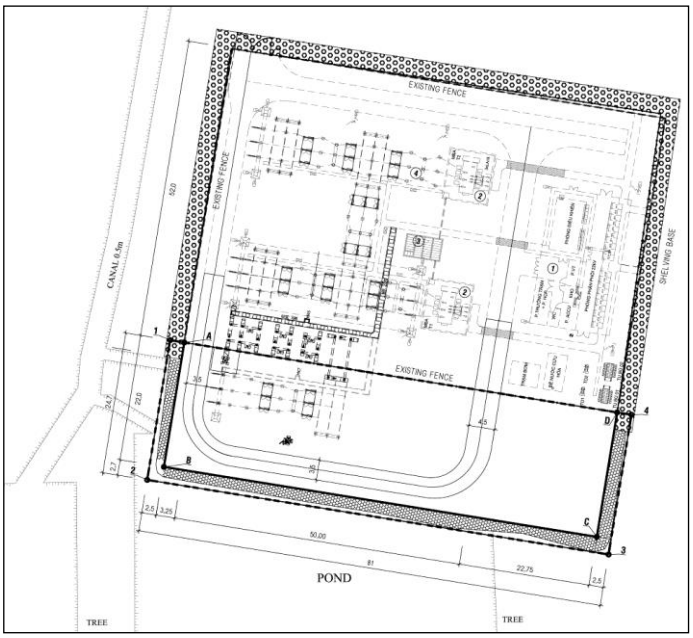


Figure 1.7. Expansion of outgoing feeder at existing 110kV Vinh Chau substation

d. 110kV and 22kV transmission line

❖ 110kV transmission line

The power line 110kV connecting Wind Power Plant No 3 wind farm to the National grid has construction scale as follows:

+ Start point	:	110kV busbar of 22/110kV Wind Power Plant No.3 (new contruction).
+ End point	:	110kV (extended) of 110kV Vinh Chau (existing).
+ Voltage	:	110kV.
+ No. of circuits	:	02 circuits (early statge with 01 circuit wired).
+ Route lenght	:	: 5.8km.
+ Conductor	:	ACSR-240/39 (Neutral oil-greased).
+ Ground wire	:	PHLOX – 59,7
+ Optical fiber		OPGW-57 (24 –single mode optical fiber)
+ Insulators	:	Glass, porcelain or Polymer 110kV, types of 70kN and 120kN.
+ Tower	:	Double circuit galvanized steel.
+ Foundation	:	On-site casted reinforced concrete.
+ Earthing	:	Galvanized steel, rod-ray mixed type.

The route passes through Vinh Phuoc ward and ward 1, Vinh Chau town, Soc Trang province.

Main parameters:

- Length of the whole route: 5.8 km.
- Total number of steering angles: 9 angular positions including starting point (ĐĐ) and end point (ĐC).
- Number of times the crossover lines are: 07 crossings of medium voltage lines, 02 low voltage lines.
- Number of houses and structures affected on the whole linear from the heart to each side is 8m: 01 house, 02 warehouses, 1 kitchen, 09 huts, 01 chicken coop and 02 graves + grave area.

➢ **Section from PT1 (NXT 110kV at 22 / 110kV substation No. 3 wind power plant) to the ĐĐ**

Length: 50m.

The section passes through Vinh Phuoc ward, Vinh Chau town, Soc Trang province.

➢ **Section from ĐĐ to G1**

Length: 200.99m.

The location of the company is located near the 110kV station, which is expected to be built in the area of Vinh Phuoc ward, Vinh Chau town, Soc Trang province.

This entire route is in Vinh Phuoc ward. The route mainly cuts through aquaculture ponds, the terrain passes through relatively flat.

There is a hut located in the 8m corridor.

➢ **Section from G1 to G2**

Length: 613.23m.

Driving angle at G1: Must be 16º20 '28'.

The terrain of the route passing through is relatively flat, mainly cut through ponds and agricultural land, longan, and pine trees, etc. The route cuts through 6 ditches and ponds, 1 medium voltage line, 1 communication line, 1 road. plastic + 2 dirt roads.

There is 1 house, 1 kitchen and 1 grave in the affected corridor.

The route is located in Vinh Phuoc ward, Vinh Chau town, Soc Trang province.

➢ **Section from G2 to G3**

Length: 827.52m.

Driving angle at G2: Left13º9 '40 ".

The terrain of the route passing through is relatively flat, mainly cutting through soil growing fruit and fruit trees such as longan, ...

The route cuts through 12 ditches, canals and ponds.

There is a hut in the corridor.

The route is located in Vinh Phuoc ward, Vinh Chau town, Soc Trang province.

➢ **Section from G3 to G4**

Length: 578.72m.

Driving angle at G3: Right25º6 '0'.

The terrain passing through is relatively flat, mainly cutting through ponds and growing land.

The route cuts through 1 dirt road and South Hau River road at Km 120 + 293. The route also intersects with a medium voltage line and a low voltage line.

The route cuts through 7 ponds.

There is a hut in the corridor of the affected road.

The route is located in Vinh Phuoc ward, Vinh Chau town, Soc Trang province.

- **Section from G4 to G5**

Length: 1791.75m.

Steering angle at G4: Right 66º53 '9'.

The terrain of the route passing through is relatively flat, mainly cutting through aquaculture ponds. The route cuts through 1 concrete road and 2 dirt roads.

The line intersects with the 110kV Soc Trang - Vinh Chau line at the interval of T166-T167, a medium and low voltage line and 2 low-voltage lines.

The route cuts through 15 ponds and channels.

There are 3 huts in the corridor of the affected road.

The route is located in Vinh Phuoc ward, Vinh Chau town, Soc Trang province.

- **Section from G5 to G6**

Length: 1185.22m.

Driving angle at G5: Right 20º45 '57 "

The terrain of the passing road is relatively flat, mainly cutting through pond land and bare land. The route cuts through 1 concrete road and 2 dirt roads. In addition, the route also intersects with a medium voltage line and a mixed medium and low voltage line.

The route cuts through 7 ditches and ponds.

There are 2 huts (1 cut, 1 in the hallway), 1 chicken coop and 1 grave in the corridor affected.

The route is located in Vinh Phuoc ward and ward 1, Vinh Chau town, Soc Trang province.

- **Section from G6 to G7**

Length: 340m.

Driving angle at G6: Right 85º57 '33 ".

The terrain passing through is relatively flat, mainly cutting through ponds, bare land, ... The route cuts through 2 asphalt roads.

The route intersects with the 110kV Soc Trang - Vinh Chau line at the interval of T174-T175 and 2 medium-voltage lines.

The route cuts through 1 channel and 2 ponds.

There is a warehouse, an abandoned warehouse and a hut in the corridor.

The route is located in ward 1, Vinh Chau town, Soc Trang province.

- **Section from G7 to DC**

Length: 132.28m.

Driving angle at G7: Left79º33 '0 ".

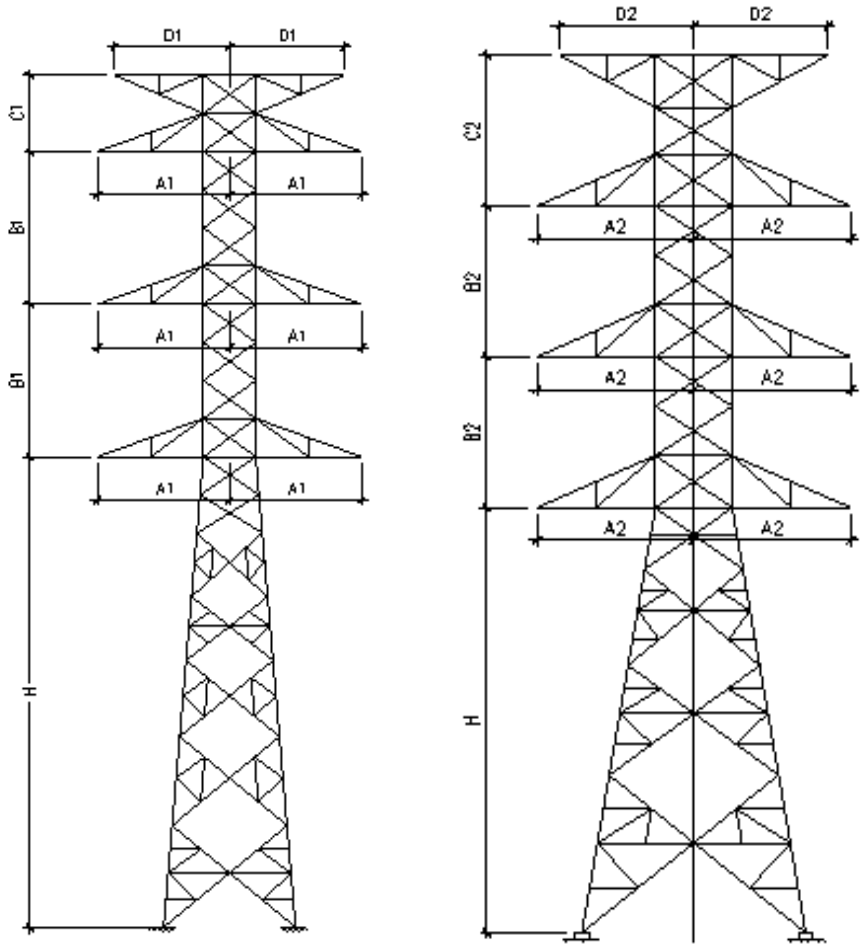
G7 position is expected to be located under the 110kV Soc Trang - Vinh Chau transmission line at the column of T174-T175. The terrain of the route passing through is relatively flat, mainly cutting through trash trees and ponds. The end of the route stops at the position before the 110kV Vinh Chau cracker station.

The route is located in ward 1, Vinh Chau town, Soc Trang province.

- **Section from ĐC to PT2 (110kV NXT expanded at Vinh Chau 110kV substation)**

Length: 50m.

The route is located in ward 1, Vinh Chau town, Soc Trang province.



Suspention **Tension**

Figure 1.8. Typical tower forms

Volume tower on the route

Table 1.6. List of tower types on the 110kV line route

No	Tower name	Angle Max	Weight (Kg)	Span of wind towers (m)	Span of weight (m)	Qt'y	Overall weight (Kg)
1	Đ122-34C		5,992.08	350	350	7	41,944.56
2	Đ122-37C		7030.34	350	350	4	28,121.36
3	Đ122-45C		11,766.60	350	350	2	23,533.20
4	N122-32A	$\leq 30^0$	12,195.73	350	350	3	36,587.19
5	N122-42A	$\leq 30^0$	17,886.19	350	350	1	17,886.19
6	N122-52B	$\leq 60^0$	28,243.75	350	350	2	56,487.50
7	N122-32B		13,341.50	350	350	1	13,341.50
8	N122-32C	$\leq 90^0$	14,998.40	350	350	1	14,998.40
9	N122-37C	$\leq 90^0$	18,471.30	350	350	1	18,471.30
Total						**22**	**251,371.20**

Source: Feasibility Study, PECC3, March 2019

Volume Foundation on the route

Table 1.7. List of foundation types on the 110kV connecting line route

No	Foundation name	Bedding sand	Volume of once foundation				QT'y
			B20	B3,5	Total concrete	Steel	
			m^3	m^3	m^3	kg	
1	MB3,2-11x11	36,30	85,13	18,72	103,85	4668,7	3
2	MB32-11x11A	43,20	82,16	18,72	100,88	4518,7	4
3	MB35-11x11	36,30	85,13	18,72	18,72	4668,7	3
4	MB35-11x11A	43,20	82,16	18,72	18,72	4518,7	1
5	MB43-12x12	43,20	95,93	22,23	22,23	5473,7	2
6	MB75-12x16	57,60	126,75	29,26	29,26	8851,2	1
7	MB75-12x16A	66,30	126,75	29,26	156,01	9001,2	2
8	MB75-14x16	67,20	145,24	34,12	179,36	10042,2	1
9	MB104-14x16	67,20	145,24	34,12	179,36	10742,2	1
10	MB75-16x16	76,80	157,47	38,98	196,45	11442,2	1
11	MB90-16x16	76,80	157,47	38,98	196,45	11442,2	1
12	MB134-18x18	97,20	192,92	49,30	242,22	13050,1	1
13	MB134-18x18A	108,30	189,79	49,30	239,09	12850,1	1
						Total	**22**

Source: Feasibility Study, PECC3, March 2019

❖ 22kV connection line

New construction of a single 22kV single circuit line with a length of about 80m connecting between column 29 / 14B / 41/6 and column 29 / 14B / 41/7 of 473-477VC from Vinh Chau 110kV substation along the existing land road In order to power self-powered transformers, the 22kV line has the following scale:

+ Start point	:	between column 29 / 14B / 41/6 and column 29 / 14B / 41/7 belongs to the export line 473-477VC
+ End point	:	Self-supporting transformer placed in 110-KV substation No. 3 wind power plant
+ Voltage	:	22kV.
+ No. of circuits	:	03 phases
+ Route lenght	:	80m.
+ Conductor	:	ACX / WBCC-70mm^2 conductors
+ Insulators	:	Porcelain support is made of high quality glass or ceramic, the string is made of composite insulation.
+ Tower	:	PC.I-14-190-13.TCVN 5847: 2016
+ Foundation	:	Reinforced concrete
+ Earthing	:	Galvanized steel, rod-ray mixed type.

e. Traffic roads

e.1. Roads in the substation area:

– Station road 6.5m wide; curvature radius of the road is 8m, the slope along the road is about 0.1%, the slope of the road is 2%. The road has the following structure:

  + Stone concrete B25 1x2; 250mm thick;

  + Stone concrete B10 1x2; 50mm thick;

  + Graded aggregates I (D_{max}=25mm) thickness of 200mm with k≥0.98;

  + Ground compacted k≥0,95.

– On the side of the road, placing B15 concrete bar size 200x400x1000, Slit width x depth = 50x50mm separated by 1m to collect water into the road, especially at the hole of water collection is cut to fit the water collection hole.

– Roads in the station are constructed after buried grounding system, at the same time must pay attention to preserve the cable conduit through the cable raceways, test ditches and drainage system, etc.

– Road-02 is 2,556m long, Road-03 is 1,442 long, Road-04 is 445m long, Road-05 is 443m long and Road-06 is 277m long.

e.2. Road outside the substation:

– Motorway outside the station is 6.5m wide and connected to the existing traffic road HL48, 533m Road-01 road.

1.4.2.3 Subs-items

(1) Auxiliary work items of the operation phase

❖ Technical solution for control, measurement and protection system

Control system

- All function of wind turbine and step-up station 22kV will be control either on site or remote by software and communicate with central SCADA system at substation Wind Power Plant No 3 as well as SCADA system at A2.
- Wind farm will operate completely automatically, except for shutdown due to faults and maintenance.

Measurement system:

- All measurement system will be able to communicate with SCADA system.
- Outgoing feeder will be measured parameters: A, V, W, Var, Wh, Varh, f, cos φ
- Auxiliary source will be measured parameters: A, V including AC and DC.

Protection system:

All protection relaya are digital relay and has communication port with computer and SCADA system:

- Protection step-up transformer
- Protection incoming bay
- Protection feeder

All circuit breakers and disconnectors shall be interlocked corresponding to diagram to advoid incorrect action as well as risk for operator and equipment.

❖ Solution of lightning protection, earthing

Overvoltage and lightning protection:

- Protection of atmospheric overvoltage spreading from power line is carried out by mean of lightning arrester installed at underground cable terminals 22kV at connecting point.
- Protection of direct lightning for wind turbine, step-up transformer and

equipment is taken place by mean of lightning rod on top of turbine.

Earthing system:

- Parameters of earthing system is determined on the basis of calculation of heat-mechanical reliability, contact voltage, voltage step-by IEEE 80-2000 and grounding values of turbine systems as required not larger than 4 Ohm.
- Earthing system of step-up station area is designed including a horizontal grid buried at 0.8m deep 50x5mm flat steel piles combine hot-dip galvanized steel L63x63x6. All equipment, shelving and cabinets are grounded. At connecting point of earthing system and grounding wire from equipment will use electric welding.
- For overhead line, re-grounding will be carried out at every 200-250m, branching point, end point etc and equipment mounted pole.
- In order to avoid the status of the earthing wires of centrifugal concrete poles are frequently stolen, using a Ø10 round steel as an independent earthing wire, it is not force bearing steel for pole and placed inside pole from the end to the base of the pole. The Ø10 round steel is led out of the pole by electrical welding with a square nut with size of 60x60x10mm.
- The earthing wire is connected from the outside of the pole to the neutral wire with 25mm^2 bare copper wire in combination with Ø14 tin plated copper terminals.
- The earthing rod of circular steel with a diameter of 16mm and 2.4m is hot dip galvanized with a galvanized thickness of 80μm. At the connection position must be used aluminum-copper clamps.
- Re-grounding will apply combined horizontal grid and pile. However, due to large area and different geological conditions, in particular position it is needed to check and reconsider in order to meet requirements.

❖ Fire protection system

The project is equipped with fire and explosion protection system to detect fire and explosion in a timely manner, and equip firefighting equipment in places such as water tanks, and basic firefighting equipment such as sand, shovel, CO_2 extinguisher etc.

The fire prevention system for the station is expected as follows:

- Oil collected tank for transformer shall be able to contain entire oil from transformer 40MVA.
- Being equipped firefighting tools like sand, extinguisher or specialized means of the fire prevention and fighting forces.

In addition, it is necessary to have assistance from the fire prevention police near the location of substation 22/110kV Wind Power Plant No 3.

❖ Operator

Scale: The size of the operator is 1,450ha, one storey house, including functional rooms such as:

- Control room
- ACCU Room
- Waiting room
- The restroom
- 24kV cabinet room

Structural solution

- Fully reinforced concrete frame, roofed iron.
- Reinforced concrete foundation stone 1x2 B15 cast in place.

(2) Items of auxiliary works

Items of auxiliary works in construction phase

❖ Storage ground for the construction phase

Warehouses and materials are used on the surface by yards in the area at the foot of the turbine. The area of each warehouse is about 1,600m2, presented as follows:

Table 1.8. Auxiliary area

No.	Items	Area (ha)
1	Excavation slope and temporary soil yard	0.105
2	Site controlling committee	0.960
3	Concrete mixer	0.280
	Total	**1.345**

Source: Feasibility Study, PECC3, March 2019

❖ Construction area

Construction site is located at the substation location. At the site, there are warehouse, yard to store materials, work for the construction committee, guest house workers.

❖ Turbine construction yard.

Turbine construction site for the project with dimension as Figure 1.4

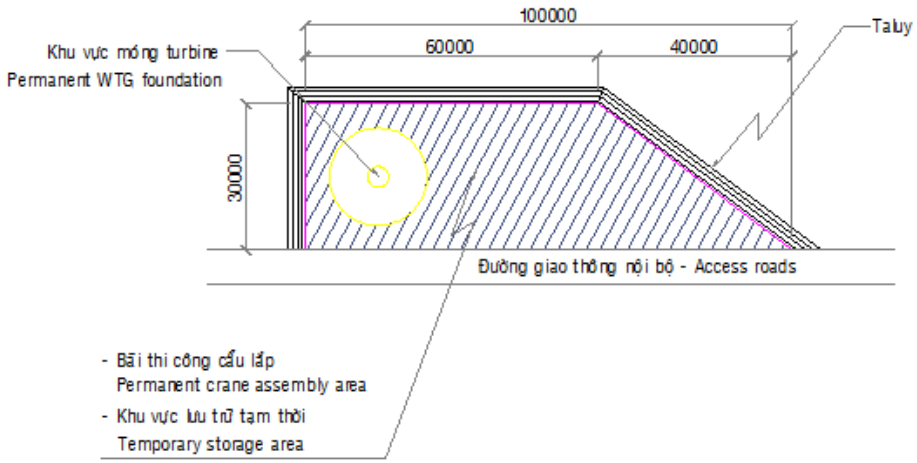


Figure 1.9. Turbine construction site

Structure of turbine installation site: Grade of macadam aggregate type 1 Dmax = 25mm, thickness of 15cm, K> = 0.98; Gravel gradation grade 1 Dmax = 37.5mm, 30cm thick, K> = 0.98; sand embarkment K> 0.95 (Combined with geotextile).

❖ Construction workers

Based on the construction volume, the total number of workers involved in construction activities is estimated at 100.

❖ Solid waste collection sites

The solid waste generated during the construction process is collected at the waste collection site at the construction area:

- Construction solid waste: construction waste materials such as iron, scraps, bricks, stones, cement, etc. will be reused for leveling (brick, stone, cement, etc.) or sell scrap (iron, steel, ...)
- Domestic waste shall be collected and concentrated at gathering area. Project owners and construction contractors hire local waste collection teams to collect and transport them for disposal.

❖ Hazardous waste collection sites

- Hazardous wastes generated during construction such as lubricants, oil mats, etc. are collected and concentrated at construction sites.
- The project owner will contract with the functional unit to handle hazardous waste generated at the site.

❖ Solid waste collection sites

- Produced solid waste: damaged equipment (cables, porcelain, etc.) in operation, generating about 30-50kg / year, to be recovered for maintenance, repair or sell off.

- Daily solid waste: about 10 kg/day, collected and stored in the trash bin near the substation gate. The substation hires the local waste collection to collect and transports for treatment..

  ❖ Hazardous waste collection sites

- Mainly waste ink cartridges, waste bulbs, waste batteries, oil rag ...
- The substation will also have a separate hazardous waste storage area. All hazardous wastes are stored in packages, labeled containers with lids and assigned to the specialized unit for transportation and treatment through a hazardous waste treatment contract.

❖ Clearance and compensation, resettlement

According to the preliminary survey in March 2019 for the project design, the volume of compensation and ground clearance of the project as follows:

Table 1.9. Area of land for a fixed-term period

No.	Items	Area (ha)
1	Turbine foundation	0,266
2	Crane yard	1,616
3	Station 22/110kV and Control room	1,450
4	110kV line	0,380
5	Vinh Chau outgoing compartment	0,318
6	Road	6,245
	Total	**10,220**

Source: Feasibility Study, PECC3, March 2019

1.4.3 MEASURES TO ORGANIZE CONSTRUCTION AND CONSTRUCTION TECHNOLOGY OF CONSTRUCTION ITEMS

1.4.3.1 Measures and Volume of Construction Works

(1) Wind power plant (Operation + Towers)

1.1 Construction ground

The construction site is quite empty with no other buildings around, only some natural shrimp ponds in the area.

Material yards are generally arranged on temporary premises in the planned area for each turbine.

Construction of common equipment storage area for the whole factory, construction of a temporary closed warehouse to gather equipment in the house.

1.2 Transporting equipment solution from port to site:

Place to receive equipments: Cai Cui Port.

Characteristics: Cai Cui Port has a favorable position that the port is located near the project and is an international gateway port of Vietnam that can receive super big ships of over 20 thousand tons.

Delivery place: Construction site of wind power plant No. 3 in Vinh Phuoc ward, Vinh Chau town, Soc Trang province.

Characteristics of the project area are located on relatively flat areas, the location of the factory is located near the roads and coastal areas of Vinh Chau town, so it is very convenient for transporting equipment of the plant by road and waterway. However, during this period only mentioned transportation by road, the waterway transport to the construction site should have detailed research in the next steps (if selected)

Receiving goods at port:

- Grand crane of loading and unloading vessel from ship to specialized hook on the wharf.
- Use 02-04 trailer trailer group to directly receive all packages from foreign ships to the port yard to release the ship. Use two cranes with 90 ^ 120 ton lifting capacity to load and unload goods from vehicles to the port yard.

Receiving goods to vehicles: Crane loading and unloading goods from port yard to specialized transport vehicles.

Road transport route: Cai Cui port depot => Road QL91C (South Song Hau) => Le Lai Street => HL31 Road => Road to the project Wind Power Plant No. 3 => Warehouse for gathering materials at site. Transport distance: ~ 110km.

Loading and unloading goods at the construction site: Equipment and goods are unloaded and arranged in each area for each type of goods to facilitate the installation process.

(2) 110kV transmionsion line

1.1 Closed warehouse, open warehouse, open space:

Based on the volume of materials and equipment used for construction, construction time, storage time and material storage areas, sheds are calculated as below.

Closed warehouse contains cement, insulation, fittings. Closed warehouse was built as a structural assembly for ease of disassembly: brick foundation, wood columns (or steel), wood trusses (or steel), tin roof (or asbestos-cement), covered with plywood walls (or plaited). In the first phase closed stores used to store cement, and then can contain other materials and equipment.

Roof openings warehouse accommodates grounding, formwork, anchor bolts, and processed steel foundation; in some case is used for minor repair as bent reinforcing steel, formwork correction. This type of warehouse made of bamboo, not needed around cover, tiled floor exalted or cement mortar.

Opened dump is used to place steel columns, cord, formwork, motorcycles and construction equipment etc. It is leveled flat, surrounded by protective barriers, and lighting system protect.

For the positions where foundation is able to transport do not required yard feeder supplies.

For locations are not able to transport foundation, supplies are gathered along the highway, or the existing road, and then transported by hand or a small truck on each foundation location.

Table 1.10. Warehouse area of the project

No.	Categories	Unit	Quantity	Norm	Area (m^2)
1	Closed warehouse: - Cement Total	Ton	2500	25T/m^2	100
2	Opened warehouse: - Grounding, steel foundation - Anchor bolt - Forms, trees against - Reinforcement Total	Ton Ton Ton Ton	56 10 4,5 86	2T/m^2 2T/m^2 1.3T/m^2 2T/m^2	38 5 5 43 **91**
3	Open-air court: - Tower - Conductor, ground wire - Insulators, accessories Total	Ton Ton Ton	130 30 220	2T/m^2 2T/m^2 2T/m^2	65 15 11 **91**

Source: Feasibility Study, TVXDĐ3, 05/2019

1.2 Material supply (domestic, imported)

- Steel columns, anchor bolts, grounding .... Get in Soc Trang
- Imported materials such as wire, porcelain, accessories, etc. are taken at Ban A.
- Local materials such as sand, stone, wood, bamboo are taken at factories, mines in localities where the line passes.
- Cement used by Ha Tien or Nghi Son factories ... in Soc Trang

Table 1.11. Supplies of equipment and materials

No.	Name of equipment	Source	Receiver	Note
1	Steel Column, Anchor Bolt, Grounding	Soc Trang	Site	Domestic processing

2	Cement PC.30	Soc Trang	-	Domestic production
3	Types of steel	Soc Trang	-	-
4	Conductor	warehouse of A	-	-
5	Ground wire	-	-	-
6	Insulator	-	-	Imported
7	Fitting	-	-	-
8	Sand	Soc Trang	-	Local material
9	Stone	-	-	-
10	Wood scaffold	-	-	-

Source: Feasibility Study, TVXDĐ3, 05/2019

The distance of transporting materials and equipment

Local materials and equipment are transported to the construction site at the site with a range of about 5km.

Type of transport route: type 3 in average.

110kV conductor long-way transportation

Transporting materials imported from the port to the warehouse of the offer period by cars on the highway or provincial roads. Picking up and down is carried out manually and 10 tonsteam crane.

Steel columns, wires, lightning rods, insulation and fittings shipped to temporary works along the route.

Local materials are shipped directly from the supplier to the construction sites. For the location cannot be transferred to the construction shall be transported to the material gathered location along the route.

Table 1.12 Table of transportation volume

No.	Item	Unit	Mass	Distance	Type of road
1	Steel post	Ton	251.4	120 km	Type 3
2	Conductor	Ton	39	120 km	-nt-
3	Ground wire	Ton	6,6	120 km	-nt-
4	Insulator and fitting	Ton	10	120 km	-nt-
5	Cement PC.30	Ton	1,227	5 km	-nt-
6	Steel of foundation	Ton	158	5 km	-nt-
7	Galvanized earthing	Ton	8.24	120 km	-nt-
8	Guy bolt steel	Ton	5,24	120 km	-nt-
9	Sand	m^3	1,393	5km	-nt-
10	Stone	m^3	2,733	5 km	-nt-
11	Wood, scaffold	m^3	9.2	5 km	-nt-

Source: Feasibility Study, TVXDĐ3, 05/2019

Transporting and transferring conductor 110kV

Transshipment of equipment and supplies from the main warehouse to the points of assembly along the existing internal traffic road by car.

The length of the route is 5,8km. Expected to arrange 1 construction sites. Internal average distance between the lines in the construction phase is 3 km. Such materials include cement, steel, wire, porcelain, accessories, steel columns, phase bars. Transportation for this project is the third grade.

(3) 110kV Substation

1.1 Constructing plan

In front of the substation there is an internal road of wind power plant No.3, so that is convenient for equipment, material, machines transportation for construction.

The station plan is leveled according to design requirement, and then used to be constructing plan including area for gathering material, machines, and constructing tools.

1.2 Closed/opened warehouse, opened dump:

Based on the volume of materials and equipment used for construction, construction time, storage time and material storage areas, sheds are calculated as below.

Closed warehouse contains cement, insulation, fittings. Closed warehouse was

built as a structural assembly for ease of disassembly: brick foundation, wood columns (or steel), wood trusses (or steel), tin roof (or asbestos-cement), covered with plywood walls (or plaited). In the first phase closed stores used to store cement, and then can contain other materials and equipment.

Opened dump is used to place steel columns, cord, formwork, motorcycles and construction equipment etc. It is leveled flat, surrounded by protective barriers, and lighting system protect.

- Warehouse for constructing station:

- Closed warehouse to store cement and fittings: 100 tons
- According to norm, $1m^2$ store 1.3ton cement.

  $S = 1,5x1,4x100x10 / (26x1,3) = 60\ m^2$
- In first stage, warehouse is used to store cement and then for other supplies and equipment.

- Closed warehouse to store constructing tools:

- Constructing station includes many parts with different activities, so it is necessary to have storage for those constructing tools, estimated area S=20m2
- The total area of closed warehouse is 80 m2.

➢ Workshop (opened storage) for processing reinforcement, formwork, and earthing:

- Total quantity of used round steel core: 10 tons.
- According to norm 1ton reinforcement needs 17 workers. So, needed workers a day: (10x17)/26 = 7 (persons).
- Normative area per worker is 6m2, usage factor 0.85. So, the actual area of opened storage is: S = (7x6)/0.85 = 50 m2.

➢ Opened dump to place materials and processed structures:

- Dump for formwork, sand and stone: 150 m2.
- Dump for steel post: 50 m2.
- Total area of opened dump: 200 m2.

1.4.3.2 Construction volume

❖ Foundation volume

Table 1.13. Volume of Foundation

No.	Item	Volume	Unit
1	Stone concrete 1x2 B35	988	m^3
2	Stone lined concrete 1x2 B20	59	m^3
3	Round steel bars (SD395)	110,000	kg
4	Excavation	1,766	m^3
5	Embankment	792	m^3
6	Steel framework	169	m^2
7	High strength mortar	0.76	m^3
8	Concrete pile PHC D700/400 type C	1,617	m
9	Steel connecting pile top ϕ10	322	kg
10	Steel connecting pile top ϕ25	4,879	kg
11	Steel plate block concrete pile connector 10mm thick	264	kg
12	Stone concrete pile 1x2 B30	5.04	m^3
13	Steel frame positioning connector ϕ25	274	kg

Source: Feasibility Study, PECC3, March 2019

❖ 110kV Transmision line volume

Table 1.14. Volume of 110kV transmission line

No	Work	Unit	Mass	Construction method
1	Digging	m^3	5,981.0	Manual and machine
2	Cover foundation hole	m^3	7,511.61	-

No	Work	Unit	Mass	Construction method
3	Bedding sand	m^3	819.6	-
4	Padded concrete B3,5	m^3	583.0	-
5	Site-made concrete foundation B20	m^3	2481.8	-
6	Processing steel of foundation	ton	157.98	Welding machine-bending, cutting
7	Processing earthing system	ton	8.24	Welding machine-bending, cutting
8	Processing anchor bolt	ton	5.24	Welding machine-bending, cutting
9	Erecting steel post	post/ton	22/251.37	Manual and machine
10	Stringing wire ACSR-400/51	km/ton	24.7/39	-
11	Stringing lightning wire GSW- 70	km/ton	6.12/3,6	-
12	Stringing fiber optic OPGW-57	km/ton	6.12/3.1	-
13	Installing earthing system	position	22	
14	Lightning wire anchor string	string	120	-
15	Lightning wire insulator string	string	144	-
16	Fiber optic insulator string	string	44	-
17	Fiber optic anchor string	string	33	-
18	Installing fittings	one	78	
19	Embankment	position	14	7 suspention + 7 tension
20	Digging for building post	m^3	1,440	
21	Digging for stringing anchor post	m^3	360	1 tower 40m^3
22	3m bamboo being scaffold for stringing	Tree	280	16 location

Source: Feasibility Study, PECC3, March 2019

Table 1.15 Volume of 110Kv substation

No.	Work	Unit	Quantity	Construction method
1	Macadam 1x2, thickness 10cm	m^3	210	-
2	Internal road 4,0m wide	m^2	780	-
3	External road 5,0m wide	m^2	275	-
4	Gate and fence	m	240	-
5	Control building (12x24) m^2	Building	01	-
6	Oil sump tank 35m^3	Tank	1	-
7	Water supply substation	System	1	-
8	Water drainage substation	System	1	-
9	Transformer foundation 40MVA	Foundation	1	-
10	Foundation & supporter equiments 110kV, 22kV	System	1	-
11	Foundation & column of lighting column	System	1	-
12	Cable trench	System	1	-
13	Installing power transformer 40MVA	Set	1	-
14	Installing transformer for self-consuming	Set	2	-
15	Installing 110kV, 22kV distribution system	Set	1	-
16	Installing cable	Lot	1	-
17	Installing lightning protection	Set	01	-
18	Installing earthing	Lot	01	-
19	Installing protection cabinet	Set	01	-
20	Installing SCADA system	Set	1	-

Source: Feasibility Study, PECC3, March 2019

Table 1.16. Construction volume of the extension of Vinh Chau 110kV substation

No.	Work	Unit	Quantity C	Construction method
1	Macadam 1x2, thickness 10cm	m^3	150	-
2	Removed humus layer, 20cm thick, on base substation and canal area	m^3	440	
3	Filled base substation and canal	m^3	3156,52	-
4	Embankment around the base substation of the masonry, cement mortar M75	m^3	124,20	

5	Internal road	m^2	393	
6	Fence	m	120	-
7	Water drainage substation	System	1	-
8	Foundation & supporter equiments 110kV, 22kV	System	1	-
9	Foundation & column of lighting column	System	1	-
10	Cable trench	System	1	-
11	Installing 110kV, 22kV distribution system	System	1	-
12	Installing cable	Lot	1	-
13	Installing protection cabinet	System	01	-
14	Installing SCADA system	System	1	-

Source: Feasibility Study, TVXDĐ3, 05/2019

1.4.3.3 Construction solution

❖ General measures

From the characteristics of the project, construction solution is primarily manual labor associated with mechanic.

❖ Construction site

Construction site plan is relative favorable because this is new area, empty, there are no structures surrounding it.

Main construction items:

❖ Levelling ground.

❖ Construction of turbine foundations.

❖ Construction of main roads and access roads to turbine locations.

❖ Digging and installation of underground cables and earthing system.

❖ Installing turbines, electrical equipment, cabinets, panels, ...

❖ Installation of optical communication systems and other communications.

The material storage-yards are generally arranged on a temporary ground in the planned area for each turbine.

❖ Detailed construction measures for each project item are as follow**s:**

a. Wind turbines

- ***Tower of wind turbines***

Tower of wind turbine has a cylindrical steel structure which is designed and supplied completely by the contractor or made in the country according to the design by the turbine supplier.

- ***Tower foundation***

Turbine foundation helps wind turbine operate normally under load effect (gravity load, wind, earthquakes, etc.). Maximum bending moment occurs at the static state of the device when the wind speed reaches the greatest.

Foundation structure is designed based on the analysis results to calculate structure of above tower with 3 cases for calculation as follows: wind turbine operates normally; wind turbine has just been completed; special case (when wind speed frequency is 1% and blades of turbine do not turn). To calculate the stability and steel for turbine foundations, selection of foundation structure is based on calculation of specific options for both economic and technical conditions.

Materials for foundation are 1 × 2 B35 concrete concrete, CB400-V steel rebar or equivalent for main bearing steel, CB300-V reinforcement or equivalent for steel and structural steel. The thickness of concrete layer to protect steel nails is designed to suit weak corrosive conditions of water in accordance with 5.0cm. In addition, no special anti-corrosion solution is applied.

- ***Connection between tower and foundation***

For connecting tower and foundation, anchor bolts are used for easily being produced and installing steel tower. Diameter and length for anchoring of bolts are provided by the tower suppliers.

- ***Process of lifting and assembling wind turbine***

❖ Installing 05 body sections of the wind turbine tower on the foundation completed by the contractor;

❖ Installing 01 nacelle for wind turbine;

❖ Installing 01 hub;

❖ Installing 03 blades.

- ***Process of assembling mechanical equipment***

All assembly processes and steps must strictly comply with the instructions of material providers and under supervision 24/24 of the equipment supplier. When winning bid, the contractor must establish a specific installation process and must be approved by the equipment supplier.

- ***Assembly process of electrical equipment***

All assembly processes and steps must adhere strictly to standards of safety

techniques on installing electrical equipment. The installation order of electrical equipment is from the base of turbine tower upwards as follows:

- ❖ Installing sensors to measure wind speed;
- ❖ Installing electrical cables;
- ❖ Installing high-voltage cable for transformer;
- ❖ Connecting high voltage installations;
- ❖ Checking transformer cabinet…

b. 110kV substation

- ***Installation of transformer***

Transformer:

- ❖ Use the rollers to put the machine into the design;
- ❖ The loading, drying, oil fitting of the transformer accessories in accordance with the rules of construction of power projects.

Outdoor Equipment: Installation of outdoor equipment using crane, manually calibrated assembly;

Indoor equipment: Information cabinets, medium-sized cabinet: using rollers, guided manual combination put the device into the correct design…

- ***Control and distribution room***

Control room, which has dimension of (8.5 x 24) m^2 from the center line of terminal post, includes single storey building; bearing structure with reinforced concrete framework; flat roof with insulator and waterproof layer; single foundation.

- ***Outdoor Distribution System***

Foundation of the main transformer (applied to the 40 MVA transformer): cast-in-place reinforced concrete grade 200. Foundation has empty volume for containing $35m^3$ oil for the transformer. in the bottom of foundation there is oil collecting pit from which a steel pipe with Φ200 will lead oil to an emergency oil collecting tank. On the foundation surface there is steel grid covered by stone layer (dimension of 5x7, 250mm thickness) to prevent fire.

Foundation of 110 kV tower frame and foundation of equipment are as follows:

- Foundation of tower frame and foundation of equipment are single ones made of cast-in-place reinforced concrete grade 200, and on the foundation, there are anchor bolts reserved to connect with the foot of above steel structure.

- Tower frame is made of form steel which is produced in the country and connected by bolts. All structure is galvanized with protective cover of 80μm minimum thickness to prevent corrosion.
- Specially bearing frame of 110kV circuit breaker and bearing frame of 110kV disconnector will be supplied by the contractor with equipment attached.

Cable trench:

Outdoor cable trench has internal dimension of 300x300, 600x400, made of solid brick, bottom buoyant foundation made of precast reinforced concrete grade 200, trench bottom has a slope for drainage. Cable supporting frame is made of galvanized form steel and connected with trench wall by expansion bolts.

Section of cable trench crossing road is strengthened to bear load of vehicles transporting transformers (load of a vehicle H30).

Indoor cable trench has internal dimension of 600x450 (control room) and 2,150x1,200 (24kV cabinet), made of cast-in-place reinforced concrete grade 200, its cover is made of steel sheet, trench bottom has a slope for drainage. Cable supporting frame is made of galvanized form steel and connected with trench wall by expansion bolts.

Gates and fences:

The main entrance to the station is sliding sash on rail, has form steel frame and internal dimension is 6.0 m.

Auxiliary door has a leaf opening out, its internal dimension is 1.2 m.

The fence is built by brick as a wall, above it there are steel flowers to prevent thefts.

Pillars of gate, fence and foundation are made of cast-in-place reinforced concrete grade 200, connection between fence pillar foundations by tie beam made of reinforced concrete grade 200, stone 1x2.

An emergency oil collecting tank for transformer:

An emergency oil collecting tank has bottom and wall made of cast-in-place reinforced concrete grade 200, its cover is made of precast reinforced concrete. Capacity of the tank is 35m^3 from the bottom of the tank to the upper edge of pipe Φ200 at the position into the tank. Next to this tank there is one electrical water pump with a capacity of 1.5 HP used for drainage.

- ***Ventilation system of control room***

Operating rooms, working rooms are equipped with air conditioners, suction fans, and ceiling fans.

c. 22kV transmission line and 110kV connection line

Building new 22kV underground cable segments from turbines connected to overhead line, every turbine has 2 outgoing feeders. Using 24kV underground cable XLPE - Cu - 300mm^2. (3 turbines).

Building new overhead line: single circuit - 3 phases combined double circuits - 3 phases, using spun concrete poles with 14m height and conductor made of steel-cored aluminum ACKP - 240 mm^2, earth wire made of steel-cored aluminum ACKP - 150mm^2.

All 10 are connected to a 22kV grid loop open operation (the first point of each branch is connected to the 22kV busbar of 110kV substation).

d. Roads

Requirements for internal roads and ground in the construction site:

Transportation roads in the construction site have to ensure no subsidence and slipperiness to keep safety during loading and unloading, transportation and installation. Construction of internal roads and space for erection work must meet the following requirements:

- Pressure on roadbed surface: 4 tons/m^2.
- Pressure on standing crane area: 8 tons/m^2.
- Width of internal road: minimum of 6m.
- Slope of internal road: maximum of 10% (TCVN 4054:2005 Highways - Design requirements).

1.4.4 *Technology of production and operation*

1.4.3.1 Operation

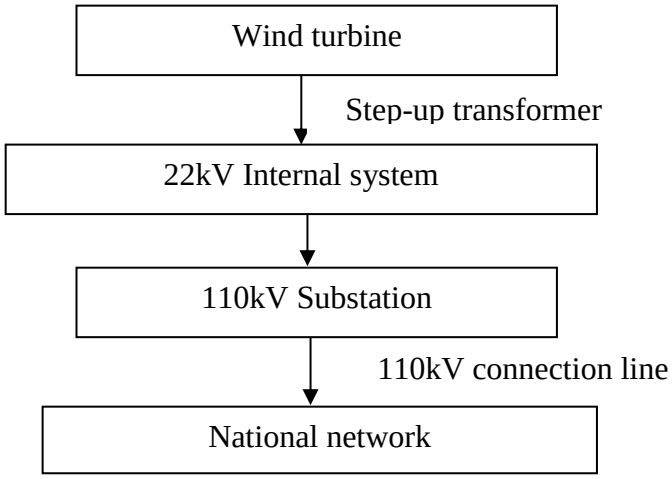


Figure 1.10. Operation process

Content of technological process of project operation:

No 3 Soc Trang wind power plant will have 07 wind turbines divided into 3 clusters, each cluster includes 4 turbines. Generation capacity of each turbine is 2.0MW through step-up transformers of 0.5-1/22 kV connected to the 22kV internal system and taken to 110kV substation which is connected to the National electricity system by 110kV - two circuit - three phase overhead line.

Specific characteristic of wind power is to use wind energy, one of the clean renewable energy types, so in the operation process it does not generate waste and pollute the environment. The operation process of wind turbines is monitored and managed through a central monitoring system located in the administration department in the plant area. The wind turbines operate automatically, and operators only must be present in case of breakdown or during maintenance.

For the 110kV substation, in the operation phase, there are only solid waste and domestic wastewater of operators. Domestic wastewater collected in a septic tank with 3 compartments located in the station area is treated to meet standards before being discharged into the receiving water source. The amount of domestic solid waste and hazardous waste will be collected and classified, after that transported and treated in accordance with regulations by the competent agency who contracts with the plant.

1.4.3.2 Maintenance

- **Turbines**

To ensure the safety of plant in operation, the maintenance must be conducted regularly as schedule of maintenance as regulated by the manufacturers. In addition, the instructions from the manufacturers of spare parts, engine parts, machinery and other recommendations in the Operational and Maintenance Manual for the plant must be applied appropriately.

The maintenance regulated by manufacturers need to comply fully and on schedule.

The maintenance must be implemented by skilled technicians (with knowledge on the wind power plant and trained by the manufacturers). After completing maintenance, the maintenance staff will issue Certificate of Maintenance to confirm the conditions of continuous working in the plant.

The maintenance complies with annual maintenance schedule of the manufacturer and complemented by two sub-schedules is that the drew-driven test and lubricant test.

Maintenance must be done properly and to have the minutes. All accessories, equipment related to the interlocking or power transmission, as well as operation status to be inspected by experts in every 2 or 4 years a time.

Annual maintenance schedule shall describe the measures and/or of limited values or range of the calibration parameters.

Drew-driven test schedule will check every bolt at important connections, tools to test driven force must be calibrated before use.

The first maintenance is after the first month of operation, all the bolts should be tested. Then, the following maintenance times (6 months per time), just check out some bolts at the rate as early regulated, the checked bolts are marked. Next time check, the other bolts will be selected for checking.

❖ **110kV Substation**

The yearly maintenance is done every year, and can include the following maintenances:

- Repair errors detected during operation;
- Clean the cooling system;
- Repairing leaks;
- Check the tightness of the bolts;
- Replace silica gel in tube;
- Maintenance of cooling fan motors;
- Cleaning insulating porcelain;

❖ **Transmission line**

- One year for line maintenance, 2 days each;
- Main maintenance is cleaning the insulator.

1.4.5 *List of machinery and equipment*

The list of machines and equipment in the construction and operation phase of the project is shown in the following table:

Table 1.17. List of machines and equipment

No.	Equipment	Unit	Quantity	Using situation
I	**Construction phase**			
1	Crane 5 tons	Unit	1	70-80%
2	Concrete mixer 250 liters	*Unit*	1	70-80%
3	Mortar mixer 150 liters	*Unit*	1	70-80%
4	Needle vibrator 1kW	*Unit*	4	70-80%
5	Platform vibrator 1kW	*Unit*	1	70-80%
6	Cam roller	*Unit*	1	70-80%
7	Compaction roller	*Unit*	1	70-80%
8	Hand electric drill 0.6kW	*Unit*	1	70-80%
9	Bar cutter 2.8kW	*Unit*	1	70-80%
10	Grinder 2.7kW	*Unit*	1	70-80%
11	Back filler	*Unit*	1	70-80%
12	Dump truck 10 tons	*Unit*	2	70-80%
13	Water truck	*Unit*	1	70-80%
14	Hydraulic jack 50 tons	*Unit*	4	70-80%
15	Oil filter	*Unit*	1	70-80%
16	Pump 1.5HP	*Unit*	1	70-80%
II	**Operation phase**			
1	Turbine 4,2MW	*Unit*	7	New 100%
2	Tower of 100m height	*Tower*	7	New 100%
3	Step-up transformer station 0,69/22kV – 2.300kVA	*Station*	7	New 100%
4	Transformer 110kV 40MVA	*Full set*	1	New 100%
5	Circuit breaker 110kV	*Set*	3	New 100%
6	Disconnector 3 phases, 110kV	*Set*	5	New 100%
7	Current transformer 110kV	*Set*	9	New 100%
8	Voltage transformer 110kV	*Set*	5	New 100%
9	Lightning arrester 96kV	*Set*	9	New 100%
10	110kV supporting insulator	*Set*	17	New 100%
11	Outdoor line connector cabinet	cabinet	3	New 100%

12	Water pump	Set	2	New 100%

Source: Feasibility Study, PECC3, March 2019

1.4.6 *Raw Material, Fuel, Equipment, and Material in Construction Phase*

1.4.5.1 Construction phase

(1) Power source for construction

Power used in the construction site is divided into 2 kinds:

- Power for construction work (taking from 80% to 90% of total consumption power in construction site), including processing material, mixing concrete, testing devices, etc.
- Power for domestic purpose and light (taking from 10% to 20% of total consumption power in the construction site).
- Power for construction is taken from 22kV existing transmission line near the construction site.

(2) Water source for construction

- Water source on site must ensure quality in compliance with standards on engineering and sanitary.
- Water used for construction work such as mixing concrete or mortar, washing stone and gravel, casting of reinforced concrete, mortaring must be clean, not contain grease and acids.
- Water for life activities must be clean and not contain microorganisms and germs and must reach standards for drinking water prescribed by the Ministry of Health.
- Water used for construction is taken from water company 300m which is far away from the project area.
- Water used for construction is only used for construction purposes, taken from regional water stations or purchased from surrounding households. Water is contained in tank trucks with a capacity of $3m^3$ and transported to the construction site. These tank trucks are equipped with exhaust pipes with a valve, so it is easy to get water when needed.

(3) Material supply sources

- All turbines, turbine supporting poles and other devices attached will be directly imported from well-known manufacturers in the world (Germany, Denmark, Spain, USA, China, etc.) and shipped to Vietnam by sea by the project owner. They are expected to be imported into Cai Cui Port then transported by road from the port to the construction site.

- For transformers, the project is expected to buy countries with many years of experience in such fields as Switzerland, England, Korea, Japan, etc. The selection of transformers will be done in the form of Bidding. Transformer oil will also be supplied by the contractor providing this transformer, insulating oil will ensure quality according to Vietnam Electricity Group (EVN) regulations.
- Other electric materials and equipment will be bought by the construction company in Ho Chi Minh City.
- Soil, sand… for leveling will be bought in the local area.

1.4.5.2 Operation stage

The project using wind energy to produce electricity and transmit electricity without production activities generate waste. The project uses only the following materials:

(1) Insulating oil

- According to the Vietnam Electricity (EVN), the insulating oil used in the transformer is a non-polychlorinated oil (PCBs);
- The insulating oil used at 110kV substation is mineral oil, petroleum distillate (carbonated hydrocarbon) which is mainly composed of CnH2n and Methane (CnH2n+2) according to ANSI / ASTM D3487 standard;
- The amount of insulating oil supplied by the transformer supplier when installed;
- During the operation phase, insulating oil is checked and disposed (if necessary). Inspection and treatment process is carried out in a closed process to ensure that oil does not leak into the environment. The amount of waste oil (generated when refining) will be stored in a separate hazardous waste storage, packaged, labeled, covered and transported to collect and treat hazardous waste according to regulations.

(2) Operational personnel

- The project is built on a scale of 24/24 hours. Cadres and operators work under the direct management of the station operator and in accordance with the operating modalities of the Southern Power System Control Center (A2).
- There are might 10 staff to operate the plant in 3 shifts as follows:
  + Head of plant : 1 people
  + Deputy of plant : 1 people
  + Staffs : 8 people.

(3) Electricity, water at the station

- The substation uses electricity to light, operate machinery, equipment and living (10 people). Power consumption is about 18,000 kWh / month;
- The source of water is supplied from tap water, mainly for daily life, hygiene, hand washing, etc. of staff (10 people) in the substation and watering plants...

1.4.7 Milestones of project

The progress is to 2020, particularly:

– Conceptual design: From 10/2018 to 6/2019.

– Kick-off project: 11/2019.

– Implementation and operation: 12/2020

1.4.8 Total investment

Total investment (Rounded): **1,209,574,081,310** VND

No.	Item	After tax value (vnd)	Weighted
1	Compensation, clearance	10,892,500,000	0.90%
2	Construction	211,460,501,072	17.60%
3	Equipment	744,276,381,891	61.95%
4	Project management	9,136,106,808	0.76%
5	Consultant	24,402,287,615	2.03%
6	Other	128,402,287,615	10.66%
7	Contingency	73,040,514,289	6.10%
	Total	**1,209,574,081,310**	

In particular, funds for environmental protection items are as follows:

(1). During construction phase

- 02 (60-liter) garbage cans: VND 1,000,000

- 06 mobile toilets: VND 12,000,000

- Funds for solid waste collection during the construction process: VND 5,000,000 / month;

- Expected budget for implementation of environmental monitoring report: VND 50,000,000 / year (included in the investment cost of the project).

(2). In the operation phase

Costs of environmental protection works and measures in the operation phase are as follows:

- Arranging 03 hazardous waste containers: VND1,500,000.

- Septic tank treating domestic wastewater: VND50,000,000.

- Drainage system in the station: VND50,000,000.

- Incident oil collection tank: VND100,000,000.

- Hazardous waste storage area: VND10,000,000.

- Equipping fire protection equipment: VND80,000,000

These costs are within the construction investment cost of the project.

In addition, the annual cost of environmental monitoring operation period is 50,000,000 VND / year.

1.4.9 Management and operating organization

Project management methods are implemented based on Decree No. 59/2015/NĐ-CP on June 18th, 2015 of the Government on management of construction investment project. Form of project implementation management as "the investor directly manages implementation of project" is defined as follows

- Project Owner: Banpu Power Public Company
- Management & Operation: BPP Vinh Chau Wind Power Limited Liability Company
- Consultant Agency: Power Engineering Consulting Joint Stock Company 3.

(1) Human for construction

Due to the specific nature of the project, which is mostly manual, the local workforce will be a source of labor to ensure the construction works.

It is expected that the construction workforce will be the largest of 100 people, most of the manual works are hired by local contractors to serve in the project construction process.

The local manual workers will take care of their own accommodation, while the construction workers will be accommodated at the rented houses of the local people near the foundation foundation to facilitate construction.

(2) Personnel operating the project

The project is built with a scale of 24/24 hours. Officials and operators work in shifts under the direct management of the station operator and according to the modality of operation mode of the Southern Power System dispatching center (A2).

The staff operating the plant is expected to have a total of 10 people as follows:

- Head of station:1 person
- Deputy station: 1 person
- Operator: 8 person.

Highly skilled staff will recruit throughout the country and will prioritize locally, the staff will take care of their own accommodation.

For environmental protection:

The environmental department of BPP Vinh Chau Wind Power Limited Liability Company organizes, monitors and inspects all activities related to environmental protection in the stage of construction and operation of the project as follow:

- Organize, monitor and inspect the implementation of pollution mitigation measures in the construction and operation phase;
- Coordinate with professional units to supervise environmental pollution during the construction and operation phase.

The stages of project implementation are detailed in the following table:

Table 1.18. The stages of the project

Stages of the project	Activities	Progress	Technology / method of implementation	Environment impact
1	2	3	4	5
Prepare	Land acquisition and clearance	11/2019	Manual combined with mechanical	Crops are cut down during the clearing process.
Construction	Leveling	11/2019	Manual combined with mechanical	Dust generation; Emission of gas.
	Digging	11/2019	Manual combined with mechanical	Dust generation; Emission of gas.
	Unloading construction materials	11/2019	Manual combined with mechanical	Dust generation; Emission of gas.
	Construction works	11/2019	Manual combined with mechanical	Noise generation; Generating domestic wastewater; Generation of daily life waste; Generation of construction solid waste.

Stages of the project	Activities	Progress	Technology / method of implementation	Environment impact
Operation	Operation of the transformer	From 12/2020	Operate according to the power industry regulations.	Generate transformer oil when trouble occurs.
	Maintenance	From 12/2020	Operate according to the power industry regulations.	Generation of solid waste.
	Activities of the operator	From 12/2020		Generating domestic wastewater; Generate solid waste daily.

CHAPTER 2 CONDITIONS OF NATURAL ENVIRONMENT AND SOCIO-ECONOMY IN THE PROJECT AREA

2.1 Condition of natural environment

2.1.1 *Conditions of geography, geology*

2.1.1.1 Geographical condition

Wind Power Plant No 3 is located in the south of Soc Trang province, located between the Tran De estuary and Ca Mau cape. The construction site is adjacent to the sea, 3 km from Vinh Chau Town to the Southwest. Location of construction works in Vinh Phuoc Ward, Vinh Chau Town, Vinh Chau District, Soc Trang Province.

The project area is characterized by terrain coastal plains as: natural elevation ranges from 0-2 (m); area divided by many ponds, aquaculture areas.

Transportation system has inter-district roads, inter-commune roads and many roads are cleared to the sea.

2.1.1.2 Geological characteristics

a) General geological characteristics

In general, geological characteristics at project site comprise of:

Wind power plant No. 3 is located in Vinh Phuoc ward, Vinh Chau town, Soc Trang province. The project area is located in the Cuu Long Delta, adjacent to the East Sea, with relatively flat terrain.

According to geological map 1 / 200,000 Ca Mau - Bac Lieu (C-48-XXVII & C-48-XXVIII) published by Vietnam Geological Department in 1995, the survey area covered by marine sediment mQ_{IV} , include:

- Upper Holocene - Upper part - Marine sediments ($mQ_{IV}{}^{3}{}_{2}$): Sand, silty sand, clay, shell pieces, 1-3m thick.
- Upper Holocene - Lower part - Marine sediments ($mQ_{IV}{}^{3}{}_{1}$): Sand, silty sand, clay, 1-3m thick.
- Upper Holocene - Upper part - Marine-swamp deposits ($mbQ_{IV}{}^{3}{}_{2}$): Clay, powder, undecayed stems, 1-2m thick.
- Hau Giang Formation: ($mQ_{IV}{}^{2}hg$): Sand, powder, clay, 15m thick.
- Long My Formation ($mQ_{III}{}^{3}lm$): Sand, powdered sand, powder, clay, 20-50m thick.

Stratigraphic details and structure of soil layers for each survey location, see borehole.

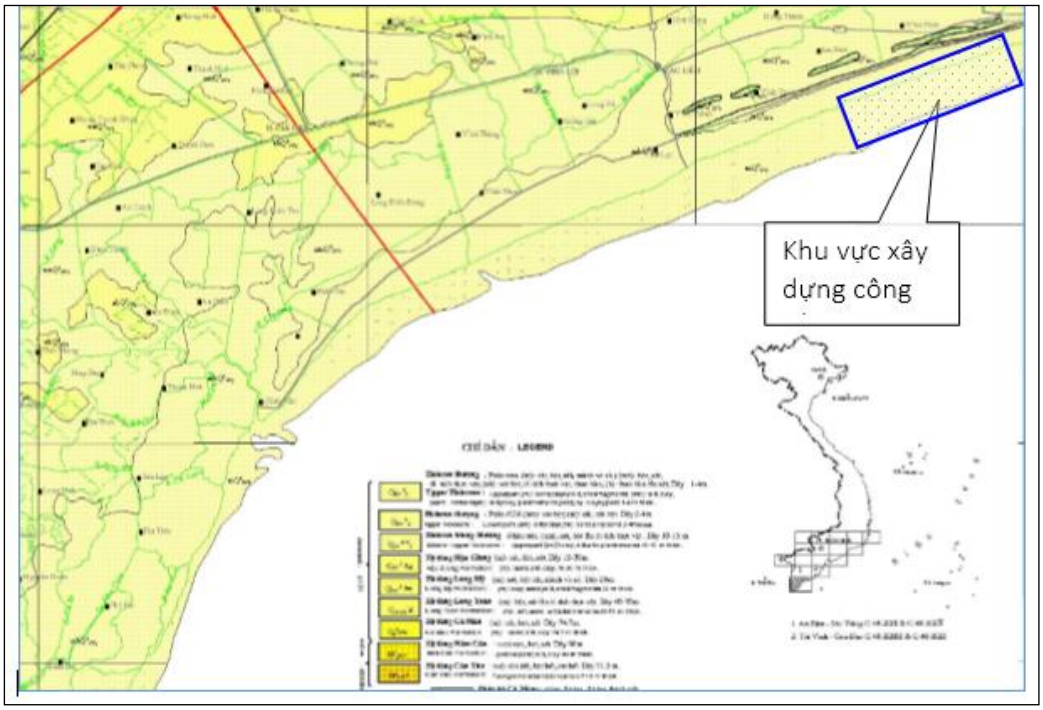


Figure 2.1. From geological map 1: 200,000 of Ca Mau - Bac Lieu map

b) Structural geology:

From the results of the field survey, experiments in the room, refer to the geological map 1: 200,000, can divide the soil and rock into the following layers:

Foundation area:

- Layer 1a and 1b (Top soil): Clay is brown gray, light brown, blue gray, plastic state flowing to soft plastic (layer 1a), hard plastic state (layer 1b). This layer is 0.4-1.6m thick, not taking samples for testing. In order to calculate the proposed design use the class 1a criteria of substation area to calculate.
- Layer 2: Clay mud is gray-brown, blue-gray. This layer is distributed below layer 1a, thickness from 18.3-20.0m
- Layer 3a: Clay, sandy clay, light brown, yellow brown, plastic state soft to hard plastic. This layer is distributed below layer 2, bottom layer elevation -21.1m (HK2) and 9.9m (HK3), average bearing capacity.
- Layer 3b: The clay is yellow-brown, blue-gray, the state is hard and hard. This layer is distributed underneath layer 3a, ending the depth of 60m is still this layer, the average bearing capacity.
- Lens 1 (TK1): Appear in borehole G2 (connection line area), depth of 0.6-1.0m, composition is sandy yellow brown, less tight.
- Lens 2 (TK2): Appears in G7 borehole (connection line area), depth of 3.5-5.0m, composition is dark gray sandy mud.

– Lens 3 (TK3): Clay, brownish-gray-green, hard plastic state, in borehole HK2, depth of 18.9-23.2m, average bearing capacity.

– Lens 4 (TK4): Sand mixed with little gray shells, medium tight state, at borehole HK2, depth of 44.3-44.8m. The lens is quite thin, can not take the sample.

– Lens 5 (TK5): gray semi-sand with plastic state,at borehole KH3, depth of 30.7-35.0m, average bearing capacity.

Geological conditions of the construction site of the operator building, from the top down, there are the following layers:

– Layer 1a (surface layer): Gray-brown clay, light brown, blue gray, plastic state flowing to soft plastic. This layer is from 1.0-2.1m thick.

– Layer 2: Brown gray clay mud. This layer is distributed underneath layer 1a, still of this layer at the end of borehole 12m , poor bearing capacity.

c) Physical and mechanical properties of soil sample:

From the results of the field geological survey (SPT) combining the results of analysis, laboratory tests, properties of each work item, the survey area is divided into 3 areas including the turbine head area, TBA area and operator, 110kV connection line area.

The connection line starting from the TBA is expected to exist in the existing 110kV Vinh Chau Station, about 5.8km long (selected plan). The terrain is relatively flat, on the 5-hole drill line at positions G2, G4, G5, G6 and G7 (location to see the surface of the drill hole).

Geological conditions of this area, from the top down, have the following layers:

– Layer 1a: Soft Clay brownish grey. This layer is 0.6-1.8m thick. The physical properties of this layer are as follows:

Grain size	Gravel (>10÷2mm)	%	0
	Sand (2÷0.05)	%	9
	Silt (0.05÷0.005mm)	%	42
	Clay (<0.005mm)	%	49
Moisture content, W		%	43.09
Natural density, γ_w		g/cm^3	1.753

Dry density (Standard value), γ_d		g/cm^3	1.225
Gravity, Δ			2.69
Void ratio			1.199
Porosity, n		%	54.5
Saturation		%	96.6
Liquid limit, W_L		%	47.1
Plastic limit, W_P		%	24.8
Plastic index, I_P		%	22.3
Liquid index, B			0.82
	Cohesiveness C	kG/cm^2	0.18
	Internal friction angle, φ	degrees	6º43’
Void ratio: e_1			1.018
Compressibility coefficient a_{1-2}		cm^2/kG	0.105
Deformation Modulus E_{1-2} *(not consider the unconfined compressive strength)*		kG/cm^2	19.5

– Layer 1b: Stiff Clay bluish grey, light brown. This layer is only found in the G7 hole, distributed on the surface to a depth of 3.5m. The physical properties of this layer are as follows:

Grain size	Gravel (>10÷2mm)	%	0
	Sand (2÷0.05)	%	11
	Silt (0.05÷0.005mm)	%	37
	Clay (<0.005mm)	%	52
Moisture content, W		%	29.24
Natural density, γ_w		g/cm^3	1.871
Dry density (Standard value), γ_d		g/cm^3	1.448
Gravity, Δ			2.72
Void ratio			0.879
Porosity, n		%	46.8
Saturation		%	90.5
Liquid limit, W_L		%	41.6
Plastic limit, W_P		%	23.9

Plastic index, I_P		%	17.7
Liquid index, B			0.30
	Cohesiveness C	kG/cm^2	0.32
	Internal friction angle, φ	degrees	14^{o}35’
Void ratio: e_1			0.828
Compressibility coefficient a_{1-2}		cm^2/kG	0.034
Deformation Modulus E_{1-2} *(not consider the unconfined compressive strength)*		kG/cm^2	53.8

– Layer 2: Very soft Clay dark brownish grey. This layer is distributed below the layer 1a and 1b, all 5 holes in the Transmission line at the end of the hole at a depth of 12m not finished this layer. The physical properties of this layer are as follows

Grain size	Gravel (>10÷2mm)	%	0
	Sand (2÷0.05mm)	%	2
	Silt (0.05÷0.005mm)	%	57
	Clay (<0.005mm)	%	41
Moisture content, W	*Standard value*	%	61.06
Natural density, γ_w	*Standard value*	g/cm^3	1.615
	Critical state (α=0.85)		1.607
	Safe state (α=0.95)		1.601
Dry density (Standard value), γ_d		g/cm^3	1.005
Gravity, Δ			2.67
Void ratio			1.666
Porosity, n		%	62.4
Saturation		%	97.8
Liquid limit, W_L		%	58.6
Plastic limit, W_P		%	30.6
Plastic index, I_P		%	28.0
Liquid index, B			1.09
Cohesiveness C	*Standard value*	kG/cm^2	0.08
	Critical state (α=0.85)		0.07
	Safe state (α=0.95)		0.06
Internal	*Standard value*	degrees	3^{o}57’

friction angle, φ	*Critical state (α=0.85)*		2º58’
	Safe state (α=0.95)		2º22’
Void ratio: e_1			1.264
Compressibility coefficient a_{1-2}		cm^2/kG	0.179
Deformation Modulus E_{1-2} *(not consider the unconfined compressive strength)*		kG/cm^2	12.8

– TK1 (lens): Medium state Sand with clay yellowish brown. Distributed in G2 drilling hole, depth from 0.6-1.1 m. The lens is quite thin, so the sample is not taken.

– TK2 (lens): Very soft Sand with clay dark grey. Distribution in borehole G7 from 3.5-5.0m depth. The physical properties of this lens are as follows:

rain size	Gravel (>10÷2mm)	%	0
	Sand (2÷0.05)	%	62
	Silt (0.05÷0.005mm)	%	33
	Clay (<0.005mm)	%	5
Moisture content, W		%	34.94
Natural density, γ_w		g/cm^3	1.791
Dry density (Standard value), γ_d		g/cm^3	1.327
Gravity, Δ			2.69
Void ratio			1.027
Porosity, n		%	50.7
Saturation		%	91.5
Liquid limit, W_L		%	30.0
Plastic limit, W_P		%	23.9
Plastic index, I_P		%	6.1
Liquid index, B			1.81
Cohesiveness C		kG/cm^2	0.03
Internal friction angle, φ		degrees	17º05’
Void ratio: e_1			0.938
Compressibility coefficient a_{1-2}		cm^2/kG	0.035
Deformation Modulus E_{1-2} *(not consider the unconfined compressive strength)*		kG/cm^2	55.4

2.1.2 *Natural features of project site*

The project area locates in an area with a tropical equatorial monsoon climate

with high temperature and humidity background. During the year the climate is divided into two distinct seasons: Rainy season from May to October, weather conditions are dominated by the prevalence of the southwest monsoon; During this season, high humidity is observed. November is the transition period from rainy season to dry season, although the rain is still there but began to decline in volume and appearance. Dry season from December to April next year, weather conditions are affected by the northeast monsoon with low rainfall. Since February, air temperatures have begun to rise and peak in April, May.

2.1.2.1 Meteological, Hydrological, Oceanographic measurement stations in project area

In the vicinity of Wind power plant No.3 has the following meteorological, hydrographic and Oceanographic stations:

- Meteorological stations: Soc Trang and Bac Lieu stations.
- Hydrological stations: Ganh Hao, Tran De and Dai Ngai.
- Oceanographic stations: Vung Tau.

The distance from the project location to the meteorological stations: Soc Trang is 30km, Bac Lieu station is 30km.

Table 2.1. Location of hydrological and oceanographic stations

Station name	Type	Level	Location		
			River (Sea)	Distance to estuaries	Distance to project
Tran De	Hydrological	III	Hau	3km to Tran De	37km
Dai Ngai	Hydrological	I	Hau	30km to Tran De	75km
Ganh Hao	Hydrological	I	Ganh Hao	1.5 km from the sea	60km
Vung Tau	Oceanographic	I	Vung Tau sea	-	170km

These are meteorological stations for basic investigation, it is exploited and managed by the Southern Regional Hydrometeorological Center - National Meteorological Hydrographic Center under the Ministry of Natural Resources and Environment.

2.1.2.2 Collect hydro-meteorological and oceanographic documents for project calculation.

Meteorological documents: data collection at Soc Trang meteorological station. This is a level I station, relatively complete with meteorological elements, a long

and continuous series of monitoring data, reliable document quality; quite similar to the construction area of climate conditions.

For hydrological and oceanographic documents: collect data at Ganh Hao hydrological station near the estuary, similar to the tide level in the project area.

Table 2.2. Situation of meteorological, hydrological and oceanographic documents in the project area

Station name	Type	Level	Elements and monitoring periods					Distance to project
			Water level	The largest rainfall periods	Air temperature	Frequency and speed of wind 8 main directions	Maximum wind speed in 8 main direction	
Soc trang	Meteorological	I	-	1995-2017	1998-2017	1998-2017	1998-2017	30 km
Ganh Hao	Hydrological	I	1998-2017	-	-	-	-	60 km

2.1.2.3 Air temperature

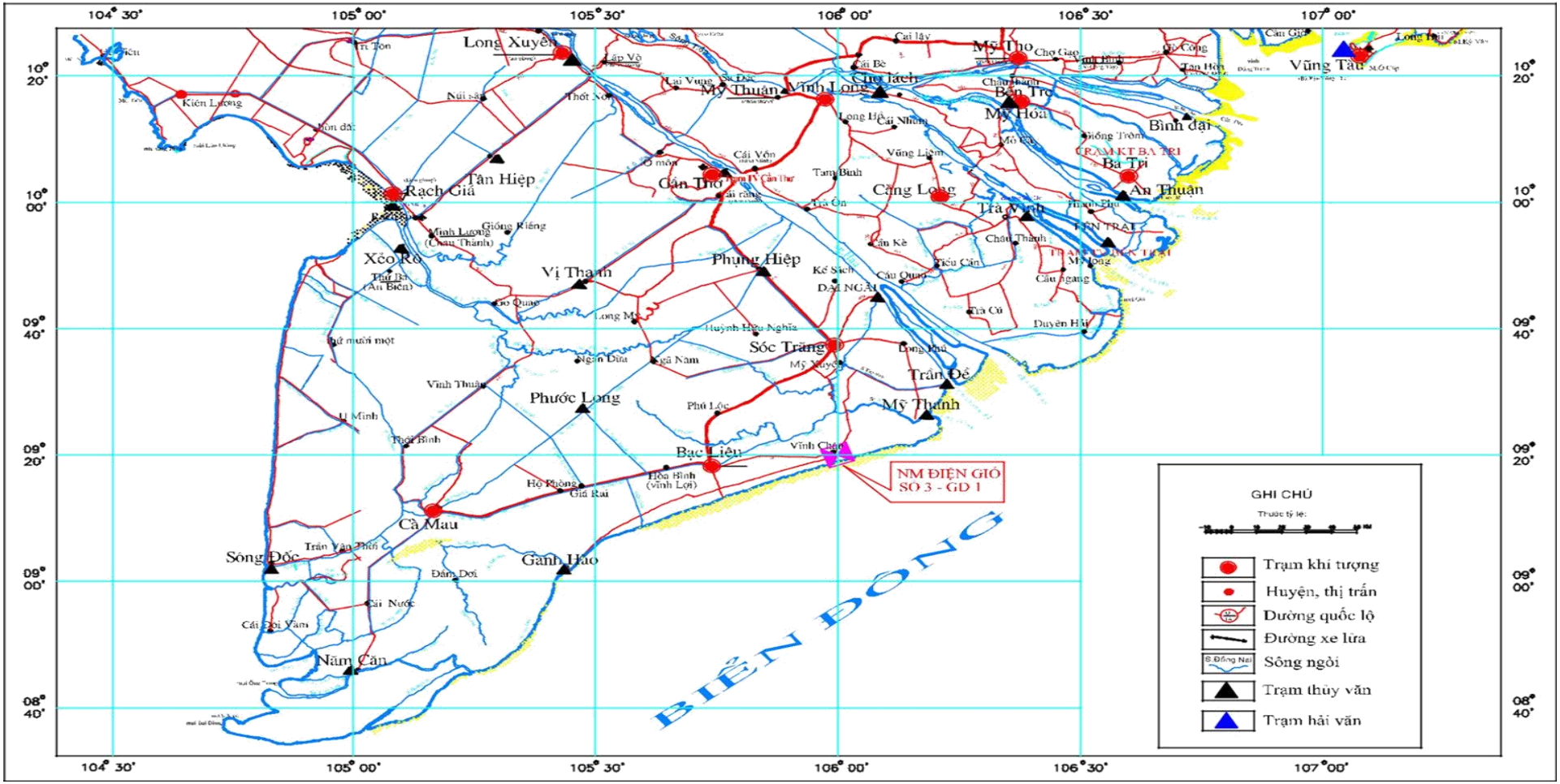


Figure 2.2. Map of hydro-meteorological and oceanographic stations

This area has a relatively high air temperature, the temperature difference between months of the year is not much different. From March the air temperature begins to increase gradually and reaches its peak around April and May. The highest air temperature is 37.2^{o}C; The average air temperature in many years is 27.0^{o}C; The lowest temperature is 16.7 ^{o}C. The monthly and yearly air temperature characteristics are shown in the table (2.3):

Table 2.3. Air temperature characteristics Soc Trang meteorological station The Period of 1998-2017

Unit(^{o}C)

Month / Featured	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
T_{avg}	25,6	26,1	27,4	28,5	28,3	27,5	27,1	27,0	26,9	27,0	27,0	26,0	**27,0**
T_{max}	35,3	34,8	36,3	36,6	37,2	35,0	34,0	34,2	34,2	33,7	33,5	33,4	**37,2**
T_{min}	17,9	18,2	20,6	22,0	22,5	21,9	21,3	21,5	21,7	21,5	20,1	16,7	**16,7**

Source: Soc Trang Met station, 2017

In which:

T_{avg}: Average air temperature.

T_{max}: Maximum air temperature.

T_{min}: Minimum air temperature.

2.1.2.4 Humidity

Relative humidity in the area is quite high. From December to May, due to low rainfall, the humidity is low. From the beginning of the rainy season, relative humidity increased and peaked in October. Average relative humidity for many years reached 84%; The absolute lowest humidity is 28%. The relative humidity characteristics shown in the table (2.4):

Table 2.4. Characteristics relative air humidity of Soc Trang station the Period of 1998 - 2017

Unit (%)

Month / Featured	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
U_{avg}	81	79	79	80	85	87	88	88	88	87	85	83	**84**
U_{min}	28	37	38	36	36	46	46	46	40	37	38	38	**28**

Source: Soc Trang Met station, 2017

In which:

U_{tb}: Average relative air humidity.

U_{min}: Minimum relative air humidity.

2.1.2.5 The Wind

➢ Wind regime

According to wind data collected at the Soc Trang meteorological station, the wind regime has two distinct seasons:

- From May to October: The prevailing winds are monsoons southwest and west, coincides with the rainy season.
- From November to April next year: The prevailing winds are the North East monsoon and the East wind, coincide with the dry season.

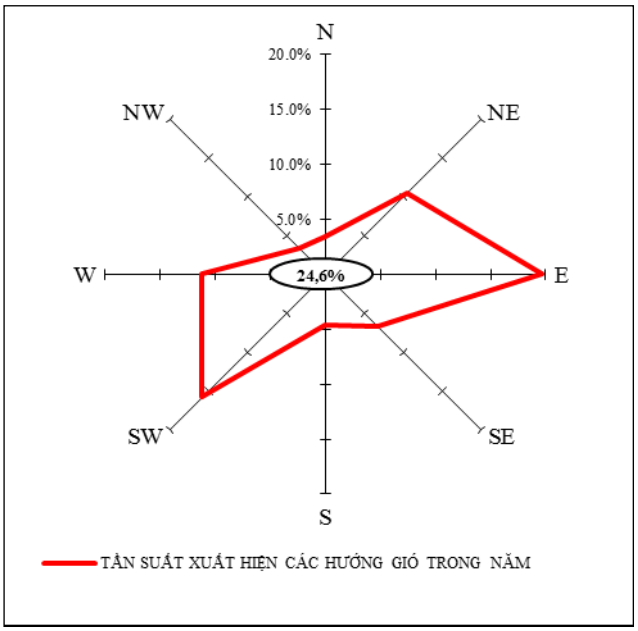


Figure 2.3. Flower winds 8 main direction in year at Soc Trang meteorological station

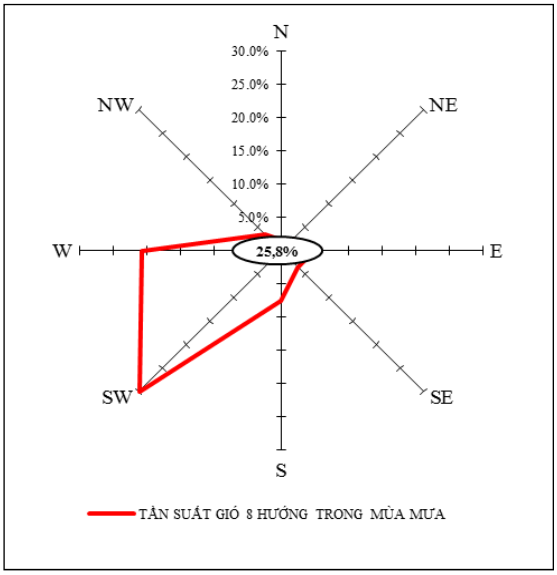


Figure 2.4. Flower winds 8 main direction in the rainy season at Soc Trang meteorological station

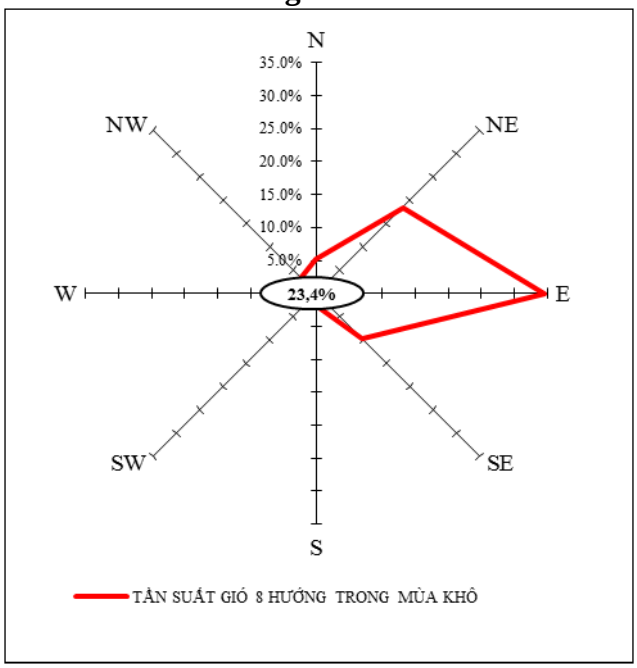


Figure 2.5. Flower winds 8 main direction in the dry season at Soc Trang meteorological station

The months with the highest frequency of occurrence of wind:

- July is southwest, August is west.
- November to December in the northeast and January to March in the east.

Table 2.5. Frequency of occurrence of wind 8 main directions of Soc Trang station the Period of 1998 - 2017

Unit: (%)

Direction / Frequency	N	NE	E	SE	S	SW	W	NW	Windless
$P(\%)_{year}$	3.4	10.5	19.7	6.7	4.6	15.8	11.3	3.4	24.6
$P(\%)_{rainy\ season}$	1.7	2.6	4.7	3.5	7.5	29.9	20.7	3.5	25.8
$P(\%)_{dry\ season}$	5.1	18.5	34.6	9.8	1.7	1.7	1.8	3.4	23.4

Source: Soc Trang Met station, 2017

➢ Wind pressure:

The maximum wind pressure at the base height is 10m from the ground at the building site (Vinh Chau town) regionally II.A, with a 3 second repetition cycle, 20 year is 0,83 kN/m^2.

Table 2.6. Average wind speed of months in the year (m/s) The Period of 1998-2017

Soc Trang meteorological station													
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Average Wind speed	1.8	2.0	2.0	1.6	1.4	1.6	1.7	1.8	1.6	1.3	1.4	1.5	1.6

Source: Soc Trang Met station, 2017

Table 2.7. Frequency of windless (PL%), average annual frequency (P%)

Soc Trang meteorological station								
PL	N	NE	E	SE	S	SW	W	NW
24.6%	3.4%	10.5%	19.7%	6.7%	4.6%	15.8%	11.3%	3.4%

Source: Soc Trang Met station, 2017

Table 2.8. Maximum design wind speed (8 directions) Soc Trang station The Period of 1998 - 2017

Unit: (m/s)

Direction / Frequency	**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**	**Scalar**
Numberof years	20	20	20	20	20	20	20	20	20
P = 1%	15.5	16.5	19.5	18.1	14.3	18.5	22.1	13.6	23.8
P = 2%	14.4	16.0	18.1	16.8	13.2	17.3	20.7	12.9	22.1
P = 3%	13.7	15.4	17.3	15.9	12.6	16.5	19.8	12.4	21.1
P = 4%	13.2	15.1	16.8	15.4	12.2	16.0	19.3	12.1	20.4
P = 5%	12.7	14.8	16.2	14.8	11.7	15.5	18.7	11.8	19.7
P = 10%	11.3	13.8	14.5	13.0	10.5	14.0	17.0	10.8	17.8
P = 20%	9.7	12.6	12.7	11.1	9.1	12.4	15.1	9.6	15.6
P = 25%	9.1	12.1	12.1	10.3	8.5	11.8	14.3	9.2	14.8
P = 50%	6.8	10.0	9.7	7.5	6.6	9.7	11.7	7.5	11.9

Source: Soc Trang Met station, 2017

2.1.2.6 Rain fall

September, October are the months with the highest rainfall. Rainy periods are from December to April each year.

+ Total rainfall in the rainy season accounts for about 83% of total annual rainfall.
+ The average annual rainfall is about 1,930mm (Soc Trang).

+ The average number of rainy days is 167 days / year.

Total rainfall and average number of rainy days in the year at Soc Trang station are shown in table (2.9):

Table 2.9. Rainfall and number of rainy days at Soc Trang meteorological station The Period of 1998-2017

Unit: (mm)

Month / Featured	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Total average rainfall	11,9	5,4	18,6	89,8	241,9	259,1	252,1	273,1	278,8	305,4	140,4	53,3	**1929,8**
Maximum rainfall day	8,2	3,0	8,8	40,8	54,8	51,0	47,4	62,5	59,2	67,4	46,3	24,7	**474,1**
Average number of rainy days	2	1	2	6	20	22	23	23	24	22	13	8	**167**

Source: Soc Trang Met station, 2017

2.1.2.7 Hours of Sunshine

Number of sunshine hours collected at Soc Trang meteorological station (according to QC 02: 2009-BXD). The months with the highest number of sunshine hours are from January to April, an average of 8 hours a day. The highest number of sunshine hours is 11.9 hours in April. September is the month with the lowest number of sunshine hours, the average day is about 5 hours of sunshine. The average number of sunshine hours in many years is 2.433 hours per year (about 6.7 hours/day).

Table 2.10. Total Average number of sunshine hours of Soc Trang station the period of 1979 - 2017

Unit: (hours)

Month / Featured	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Total average hours of sunshine	239	249	281	256	199	166	177	174	154	170	198	201	**2433**
Maximum hours of sunshine of one day	11,2	11,4	11,6	11,9	11,4	11,5	11,5	11,7	11,2	11,3	11,1	11,2	**11,9**

Source: Soc Trang Met station, 2017

2.1.2.8 The number of foggy days:

This area in the year is less fog phenomenon, average 1 year only about 1 day there appear fog.

Table 2.11. Average number of foggy days in Soc Trang the period of 1979 - 2017

Unit: (day)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Number of foggy days	0.3	0.3	0.1	0.0	0.0	0.0	0.1	0.0	0.3	0.1	0.1	0.1	**1.3**

2.1.2.9 The thunderstorms, lightning

+ Lightning density in construction area: 10.9 times/km^2/year (Vinh Chau district).
+ Number of days with average yearly thunderstorms: 88 days (Soc Trang).

The number of days with average thunderstorm in Soc Trang station is shown in table (2.12):

Table 2.12. Number of days with average thunderstorms at Soc Trang meteorological station the period of 1998- 2017

Unit: (day)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Number of thunderstorm days	1.3	1.0	2.9	6.6	16.2	14.0	11.0	12.3	11.8	11.2	4.3	1.3	**88.4**

Source: Soc Trang Met station, 2017

2.1.2.10 The storms and tropical depressions

From 1979 to 2017 there were tropical cyclones and typhoons affecting the coastal areas of the Mekong Delta. In the storms, typhoon No. 5 (Linda) occurred in November 1997, sweeping through the southern coast and landing in Ca Mau - Kien Giang. This storm has caused serious damage to people and property.

In general, this area is very less storm-prone than some parts of the country. During the year, typhoons and tropical low pressures usually occur in the months of October to December. Typhoons and tropical depressions affecting the project area are shown in the table (2.13).

Table 2.13. The storms and tropical depressions directly affected to project area (1979-2017)

No.	Year	Name of storm	Date of landing	Affected area	Level wind speed	Wind speed	
						Value (m/s)	Direction
1	1983	Herbert	Oct. 11th	Ba Ria - Vung Tau	6 -7	11	SW
2	1996	Ernie /9625	Nov. 16th	Offshore of Ba Ria -Vung Tau sea	7	10	E
3	1997	Lida/9726	Nov. 2nd	Bac Lieu - Ca Mau	8	20	NE
4	1998	Noname 9813	Dec. 11th	Ca Mau - Kien Giang	7	12	NE
5	1999	Tropical Depressions	Oct. 23rd	Ca Mau - Kien Giang	6	10	E
6	2004	Muiifa/0404	Nov. 24th	Sea Ca Mau - Kien Giang	8	10	E
7	2006	Durian/0609	Oct. 5th -6th	Ben Tre - Tra Vinh	10 -11	23	NE
8	2008	Tropical Depressions	Nov.	Offshore of South Central sea	6		
9	2009	Tropical Depressions	Nov. 23rd - 27th	Sea Binh Thuan - Ca Mau	6	7	E
10	2010	Tropical Depressions	Jun. 20th	Binh Thuan - Ca Mau	6-7	5	ESE
11	2012	Pakhar (No 1)	Mar 31st	Sea Ninh Thuan - Ba Ria Vung Tau	6-7	3	SW
12	2013	No 13	Nov. 6th -7th	Phu Yen - Ca Mau	7 -8	4	WSW
13	2014	not appear					
14	2015	not appear					
15	2017	Kirogi	Nov. 19th	Binh Thuan - Ca Mau	8	10	

2.1.3 The Hydrology and Oceanographic characteristics

2.1.3.1 The tidal characteristics in project area

Tide regime: Coastal areas in the project area have semi-irregular tide, a day and night there are 2 times the water up and 2 times the water down, There are two tidal peaks and two uneven tides. During the month, there are two periods of high tide alternating between two periods of low tides.

Tide amplitude: The sea from Vung Tau to Ca Mau is one of the sea areas with the largest tidal amplitude in Vietnam. In the Duyen Hai, the tide amplitude during ranges from 2,5 to 4,0m; The maximum tide amplitude is: $\Delta H = 5,21m$. Highest tides in the year usually occur in October, November. The lowest water level occurred in June, July.

Meteorological and hydrological factors affecting the tide level in the construction area include:

- The strong southwest monsoon and especially the northeast monsoon increase the tide.
- Storm surge.
- Rainfall also increases the water level.

2.1.3.2 The water level

Largest water level survey

At the construction site, we conducted the highest flood level survey. According to the survey, the area has never been affected by floods. However, the deepest water level (due to rain, tidal combination) is located at Mr. Thai Van Thai's house, Vinh Phuoc ward, Vinh Chau town.

Table 2.14. The Largest Water Level Survey (State Elevation System)

Survey location	Area	Maximum water level (m)	Time appears	Note
Mr. Thai Van Thai's house	Project area	2,19	10/1997	Water level is flooded by rain, tides

Source : Survey report, PECC3, March 2019

Collect water level data

Collect data of max, min and average water levels at Ganh Hao hydrological station with data series from 1998 - 2017, data provided by the Center for Meteorology, Hydrology and Environment.

Ganh Hao hydrological station has geographical coordinates: 09º01'56" North latitude; 105º25'10" East longitude. The station is located on the left bank of Ganh Hao river in Region IV of Ganh Hao town, Dong Hai district, Bac Lieu province.

Table 2.15. Water Level Characteristics at Ganh Hao Hydrological Station (1998 - 2017)

Unit : cm

Featured	Month												Year
	1	2	3	4	5	6	7	8	9	10	11	12	
H_{tb}	35	29	23	13	3	-7	-7	-4	2	28	43	43	**16.8**
H_{max}	208	221	212	204	195	173	177	180	204	223	226	230	**230**
H_{min}	-223	-217	-207	-227	-244	-245	-244	-243	-219	-212	-220	-220	-245

Source: Ganh Hao Hydrological station, 2017

Table 2.16. Maximum annual water level data at Ganh Hao station (1998 - 2017)

Unit : cm

No.	Year	Hmax (cm)	No.	Year	Hmax (cm)
1	1998	183	12	2008	210
2	1999	202	13	2009	218
3	2000	186	14	2010	209
4	2001	196	15	2011	214
5	2002	200	16	2012	223
6	2003	194	17	2013	214
7	2004	190	18	2014	212
8	2005	202	19	2015	216
9	2006	201	20	2016	218
10	2007	203	21	2017	230

Source: Ganh Hao Hydrological station, 2017

Calculate the design water level

Calculate the design frequency at Ganh Hao Hydrological Station. Table of results for calculating maximum frequency of water level is shown in appendix.

Table 2.17. Water level corresponds to the frequency of hydrological station

Unit: (m)

Frequency P (%)	1	2	5	10	20	25	50	Elevation system
Hp Ganh Hao (m)	**2,38**	2,35	2,29	2,24	2,18	2,16	2,06	Nation

The project area is 60km from Ganh Hao hydrological station, with delta terrain conditions, slope (water level) is low. Therefore, the maximum designed water level with the frequency of 1% applies to the whole project:

Maximum water level design at 1% frequency in the construction area:

$$H_P\ 1\% = 2{,}38\text{m}.$$

Survey on coastal erosion

Vietnam's coast is severely eroded, causing damage to nature, material loss and causing difficulties for human life. From the end of the twentieth century up to now, the level of erosion of the coast of Vietnam has increased from range to intensity, especially on the low bank, composed of loose sediment such as sand, mud, pebble powder.

Soc Trang coast from Cu Lao Dung to Vinh Chau town (construction area), erosion phenomenon alternating; but from Vinh Chau to the border of Bac Lieu

province eroded about 10m/year. From 1965 to now, the sea has encroached on land about 250m. The main cause of erosion:

- Natural factors: impact of wind, waves, tides, coastal currents, geological structure of coastal areas, location of shorelines.
- Human impact: deforestation of mangroves (because they are not aware of mangroves is an ecosystem that reduces the intensity of wind, waves and currents, creating favorable conditions for sediment accumulation, helping shoreline against erosion local people destroyed mangroves for aquaculture).

The coastal section in the construction area is covered by mangrove forest, so the level of erosion has leveled off.

However, in the long term, with the current climate change situation, it is necessary to have solutions to enhance the planting of mangroves, planting coconut trees, casuarina ... to build new breakwater embankments to ensure the preservation of the shoreline sea as present.

2.1.4 Situation of quality components of the physical environment

To assess the quality of the environment in the project area, Power Engineering Consulting Joint Stock Company 3 (PECC3) in collaboration with Environment and Energy Center conducted environmental measurement and result analysis in March, 2019 at the locations which are the typical environmental points in the project area.

Location map of sampling ambient air quality, surface-water is presented in Figure 2.2 below:

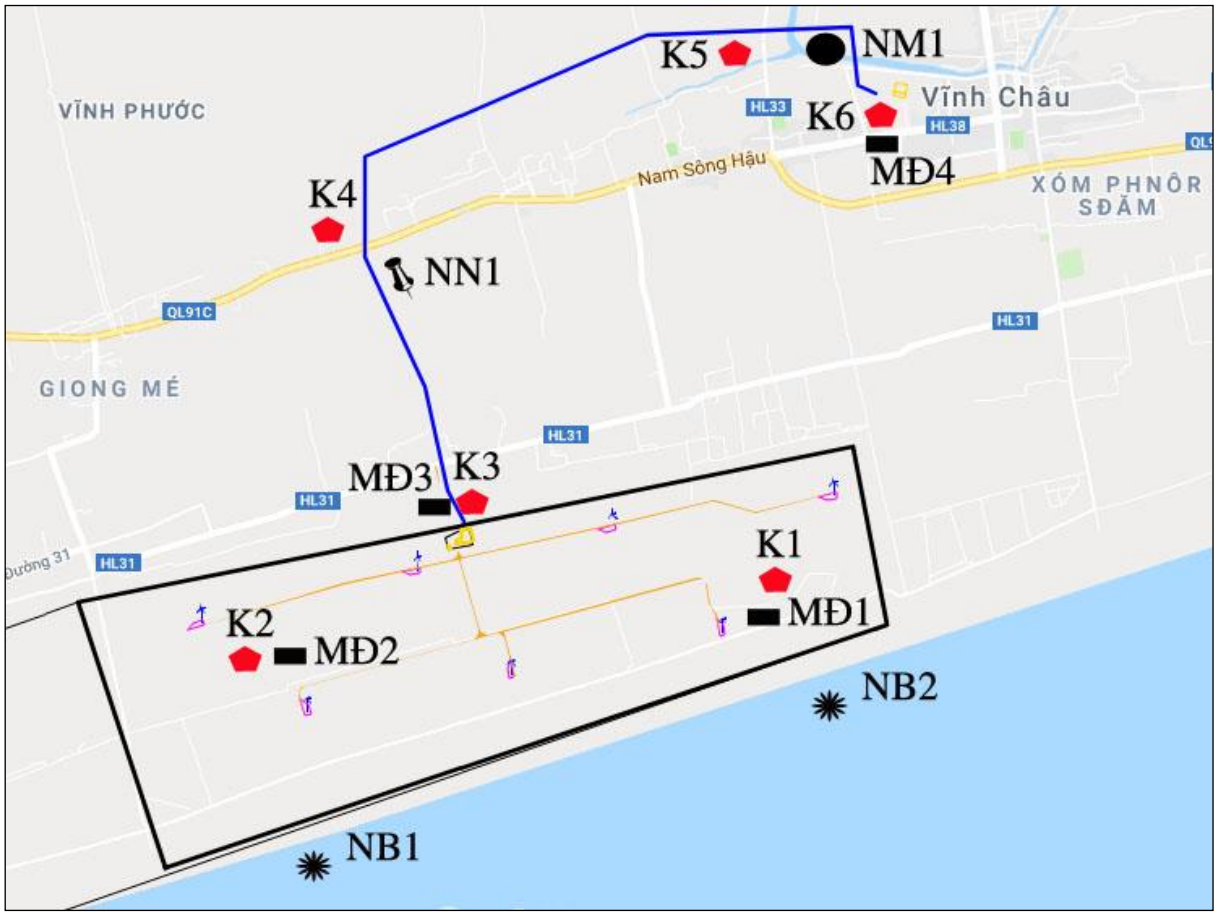


Figure 2.6. Location of taking samples of the background environment in the project area

2.1.4.1 Air quality in the project area

There are six locations taken samples to analyses as follows:

Table 2.18. Location of taking air sample

No.	Symbol	Location of taking air sample	Coordinates (VN - 2000)	
			X (m)	Y (m)
01	K1	In WPP area near turbine WTG04	1028860	551700
02	K2	In WPP area near turbine WTG01	1028120	548000
03	K3	Near 22/110kV Wind Power Plant No.3 SS	1028780	549430
04	K4	Nam Song Hau road	1030360	548940
05	K5	HL 33 road	1031760	551220
06	K6	Expanding 110kV Vinh Chau outgoing feeder	1031240	552020

Measurement and analysis results at 6 locations in the project area are presented in the following table:

Table 2.19. Analysis results of ambient air quality in the project area

Location	NO_2 (mg/m^3)	SO_2 (mg/m^3)	CO (mg/m^3)	Dust (mg/m^3)	Noise (dBA)	Temp (^0C)
K1	0.06	0.11	5.7	0.12	58 - 60	34.2
K2	0.06	0.10	5.6	0.11	54 - 56	34.2
K3	0.07	0.12	5.9	0.14	59 - 61	34.7
K4	0.11	0.17	6.3	0.20	62- 64	35.3
K5	0.08	0.14	6.0	0.17	62 - 65	34.5
K6	0.08	0.13	6.1	0.15	58 - 60	35.3
QCVN 05: 2013/BTNMT	**0.20**	**0.35**	**30**	**0.30**	**-**	**-**
QCVN 26: 2010/BTNMT	**-**	**-**	**-**	**-**	**70**	**-**

Source: Energy and Environment Center, March 2019

Remark:

The result of ambient air analysis in the project area shows that the air quality's parameters at the measurement points are lower than the permissible standards according to QCVN 05:2013/BTNMT and QCVN 26:2010/BTNMT. At the same time, the results of the analysis did not detect harmful gases. This shows that the ambient air quality in the project area is still pretty good.

2.1.4.2 Surface water quality in the project area

Table 2.20. Surface water sampling location

No	Symbol	Location	Coordinates (VN - 2000)	
			X (m)	X (m)
01	NM1	The canal Vinh Chau	1031520	551760

Results of surface-water quality measurement and analysis in the project area are as follows:

Table 2.21. Surface-water quality in the project area

No	Para-meter	Unit	Result	QCVN 08-MT: 2015/BTNMT Column B1
01	pH (*)	-	6.03	5.5 – 9
02	DO	mg/l	4.52	≥4
03	TSS (*)	mg/l	21	50

04	COD (*)	mg/l	27	30
05	BOD_5	mgO2/l	13	15
06	Coliform	MPN/100ml	5,600	7,500
07	Nitrat (NO_3^-)	mg/l	0.02	10
08	Phosphas (PO_4^{3-})	mg/l	NONE	0.3
09	Oil	mg/l	NONE	1
10	Surfactant	mg/l	NONE	0.4
11	E.coli	MPN/100ml	67	100
12	Hg	mg/l	NONE	0.001
13	As	mg/l	NONE	0.05
14	Cd	mg/l	0.004	0.01
15	Pb	mg/l	NONE	0.05

Source: Energy and Environment Center, March 2019

Note:

Currently, the irrigation canal Vinh Chau is being used for purposes of irrigation, so regulation applied to the surface water quality in this area is QCVN 08-MT:2015/BTNMT, column B1.

Remark:

The analytical results of surface water for the irrigation canal Vinh Chau in the project area compared with QCVN 08-MT:2015/BTNMT, column B1 shows the analyzed indexes are met the permissible standard.

2.1.4.3 Groundwater quality

Table 2.22. Location of taking groundwater sample

No	Symbol	Location	Coordinates (VN - 2000)	
			X (m)	X (m)
01	NN1	The well near Nam Song Hau road	1030360	548940

Results of groundwater quality measurement and analysis in the project area are shown in the following table:

Table 2.23. Groundwater quality in the project area

No	Para-meter	Unit	Result	QCVN 09- MT: 2015/BTNMT
01	pH (*)	-	5.83	5.5 – 8.5
02	Pemanganat	mg/l	1.3	4

03	TDS	mg/l	419	1,500
04	Amoni (NH4+)	mg/l	0.27	1
05	Clorua (Cl-)	mg/l	18.7	250
06	Nitrat (NO3-)	mg/l	3.49	15
07	Nitrit (NO2-)	mg/l	0.13	1
08	Sulfat (SO42-)	mg/l	8.97	400
09	Pb	mg/l	NONE	0.01
10	Fe	mg/l	3.9	5
11	Hg	mg/l	NONE	0.001
12	As	mg/l	NONE	0.05
13	Cd	mg/l	NONE	0.005
14	Coliform	MPN/100ml	NONE	3

Source: Energy and Environment Center, March 2019

Remark:

The analytical results of groundwater quality in the project area compared with QCVN 09-MT:2015/BTNMT - National Technical Regulation on groundwater quality shows the quality of groundwater sources in the project area are within the allowable limits.

2.1.4.4 Quality of soil environment

Table 2.24. Location of taking sample

No	Symbol	Location	Coordinates (VN - 2000)	
			X (m)	X (m)
01	MĐ1	In WPP area near turbine WTG04	1028860	551700
02	MĐ2	In WPP area near turbine WTG01	1028120	548000
03	MĐ3	Nam Song Hau road	1030360	548940
04	MĐ4	Expanding 110kV Vinh Chau outgoing feeder	1031240	552020

Results of soil quality measurement and analysis in the project area are shown in the following table:

Table 2.25. Quality of soil environment

No	Para-meter	Unit	Result				QCVN 03-MT: 2015/BTNMT (Agricultural land column)
			MĐ1	MĐ2	MĐ3	MĐ4	
1	As	mg/kg	0.15	0.16	0.17	0.18	**15**
2	Cd	mg/kg	0.05	0.04	0.06	0.07	**1.5**
3	Pb	mg/kg	11.73	13.21	15.88	17.24	**70**
4	Zn	mg/kg	22.57	25.31	27.97	28.68	**200**

Source: Energy and Environment Center, March 2019

Remarks:

The analytical results of groundwater quality in the project area compared with QCVN 03-MT:2015/BTNMT - National Technical Regulation on groundwater quality shows the quality of groundwater sources in the project area are within the allowable limits.

2.1.4.5 Coastal seawater quality

Table 2.26. Location of taking sample

No	Symbol	Location	Coordinates (VN - 2000)	
			X (m)	X (m)
1	NB1	Near turbine WTG07	1027730	551260
2	NB2	Near turbine WTG05	1026870	548910

Results of soil quality measurement and analysis in the project area are shown in the following table:

Table 2.27. Coastal seawater quality

No	Para-meter	Unit	Result		QCVN 10:2015/ BTNMT Other area
			NB 1	NB2	
1	Temp.	^oC	28.9	29.2	
2	pH	-	7.9	7.8	**6.5-8.5**
3	Turbidity	NTU	ND	ND	-
4	DO	mg/l	5.2	5.3	**≥5**
5	TSS	mg/l	10	8,0	-

No	Para-meter	Unit	Result		QCVN 10:2015/ BTNMT Other area
			NB 1	NB2	
6	Conductivity	-	31.42	21.12	-
7	COD	mg/l	KPH	KPH	-
8	BOD_5	mg/l	ND	ND	-
9	NH_4^+	mg/l	ND	ND	**0.5**
10	NO_3^-	mg/l	ND	ND	-
11	NO_2^-	mg/l	ND	ND	-
12	PO_4^{3-}	mg/l	0.0003	0.0002	**0.5**
13	SO_4^{2-}	mg/l	ND	ND	-
14	Hg	mg/l	0.0001	0.0001	**0.005**
15	As	mg/l	0.001	0.002	**0.05**
16	Zn	mg/l	0.005	0.0032	**2.0**
17	Pb	mg/l	0.005	0.004	**0.1**
18	Oil/grease	mg/l	ND	ND	**0.5**

Source: Energy and Environment Center, March 2019

Remarks:

All coastal seawater samples meet QCVN 10:2015/BTNMT (used for other area).

2.1.4.6 Status of biological resources

(1). Animals - terrestrial plants

Terrestrial animals

The project area is sparsely populated, so there are few species of livestock, only a very small number of livestock and birds, reptiles and insects. There are no rare animals in this area.

Terrestrial vegetation

In the project area can be divided into two main types: (1) Vegetation is typical for mangrove ecosystem, (2) and vegetation is typical for home garden and vegetable ecosystem.

The project area is represented by tree species that characterize the saline brackish water ecosystem, most notably mangrove and poplar trees due to being planted as protection forests and along the dyke. In addition, there are water

coconuts, pine trees, cucumbers, acorns, cucumbers, girders, strabismus, wild ferns, bowls, water hyacinth ...

Most of the area around the project area used for the main activity is shrimp farming. For the project area, purple onions, melons, and potatoes are the main subjects in the majority of crops with a large area, the remaining other vegetables are insignificant. For home gardens, dominance is a group of ornamental plants, for beautiful flowers grown in gardens for decoration such as porcelain, ten o'clock, periwinkle, five colors, confetti, chicken crest, marigold, balmy medicine, clearance ... planted by people in the yard. Because the land area is not suitable for growing trees, this area also has very little presence of food crops and fruit trees. The region's wild grass plants present a lot of wild plants growing on sandy soil typical of the area such as seaweed, sea spinach, u du high, sea-going, convolvulus, vegetables and cages. , grasses, fish sauce, cork, roof beams, coconut shell ...

Bird system

There are few large and rare birds in the project area, and the population is not large. Species often appear: (Ardeidae) (Egretta garzetta) (Nycticorax nycticorax) (Spilopelia chinensis) nesting on poplar forests; (Passeriformes); (Cerylidae)

At the location of Doi pagoda, about 28.5 km south of the line and 30.5 km south of the turbine construction area, is a place of bats.

(2). Aquatic plants and animals

System of aquatic organisms

Coastal fauna includes the following species:

- Molluscs: more than 70 species, of which more than 30 species of abdomen, 10 species of the first leg, 40 species of 2 pieces of shell.
- For bivalve species, there are many types: Annadata granosa concentrated in Dong Cao estuary with an area of 600 ha; Meredix lyrata, and Geloina coaxans
- Crustaceans: 109 large crustaceans, belonging to 36 genera, 15 families with economic and ecological significance such as: Shirmp, crayfish, moi and crab.
- Animal echinoderms: over 8 species distributed 1-2 km away from the shore at a depth of 25-40 m.
- Fish: includes 150 species of fish belonging to 40 families, 78 varieties are economically significant in terms of food value and yield.
- Coastal marine fish group: is a group of fish that is suitable for salinity <25% 0, they have close relationship with mangrove forest, the main food chain is plant residue humus, including 12 isolated species.
- Sea snake group: There is no document about sea snake in Tra Vinh province, but in reality, Tra Vinh province has discovered 3 species of sea snakes (rice chop, melon, and small head).

- Group of crustaceans: important for shrimp, with 51 species, the average density of one hour of tide going down in the rainy season is 25-243 individuals / m^2 (crayfish)
- Shrimps: there are 36 species, the average catch resource is 0.1-11.5 kg / hour, the depth is 20-25 m.
- Crayfishs: there are 11 species that are very rich in yield but have not yet fully exploited the economic efficiency.
- Crab group: there are 7 species, of which large export value is green crab (Scyllaserrata), portynus.
- Grapsidae: special three-ball cuffs (Sesatma singaporensis).

Aquatic plants

Vinh Chau sea area is characterized by the East Sea (Vietnam) with the condition that surface water temperature in a year rarely falls below 200C, so the marine ecosystem is tropical. The monsoon regime creates a humid, rainy regime and especially the cycle of change in the year, which also has an impact on life, especially the reproductive cycle, migration distribution of seasonal fish and shrimp. .

Mangrove vegetation is salinity tolerant and able to adapt to submerged conditions. Vegetation species include grass species with pioneering communities in the newly accretioned and stable forest communities. It is possible to list species according to the following table:

Life adventure

Species composition includes 3 main algae branches: (Cyanophyta), (Dinophyta) and (Chrysophyta).

The group of brackish and brackish water species dominates the composition of planktonic plants in the project area. In particular, typical brackish water species (salinity of about 18%) account for the majority, including Cyclotellastylorum, Coscinodiscusbipartitus, Coscinodiscusnobtilis, Skeletonemacostatum, Biddulphiaregia, Gyrorigmabalticum, Amphiproraalata, Nitzschialorengiana, Nitzschialongissima, Nitzschiaparadoxa, Nitzschiaongma ...

Floating animal composition

Floating animal composition varies depending on the season and wind direction in the year. At the time of the survey, at the beginning of the Southern wind season, the composition of the species mainly belongs to 2 crustaceans (Crustacea) (Copepoda) and (Mysidace), some water samples have detected some Daphnia species, no survey detecting polychaete worms (Annelida) in samples (only in dry season).

Bottom animal composition

Species composition includes polychaete (Polycheata) (Mollusca) and (Crustacea).

The total number of benthic animals collected in the project area is saltwater. In general, species composition and biomass of benthic fauna are quite poor. All solid-bottomed animals appear specifically for medium-contaminated bottom soil and many organic components. This is also one of the basic characteristics of estuarine areas, where water sources are interfering and where organic deposits are brought from large tributaries.

Figure 2.7. Current status of the project area

2.2 Economic conditions - social

As mentioned above, the project of Wind Power Plant No. 3 is implemented in 2 wards: Vinh Phuoc Ward and Ward 1. According to the socio-economic report of communes at the end of 2018, the economic situation society of wards and Decision No. 3429 / QD-UBND dated December 25, 2018 of the Provincial People's Committee are as follows:

2.2.1 Economic conditions – social Vinh Phuoc Ward

2.2.1.1 The economic situation

- Manufacturing and Agriculture - Fisheries - Forestry

People's rice area is 184 hectares were sown to reach 76.67% of the plan, compared to the same period decreased 68 hectares. 184 hectares harvested, yeild 5 tons / ha, quantity 920 tonnes 76.67% of the plan.

Crop production area is 1,291 hectares sown, reaching 105.82% targets including 77 hectares of food crops reached 128.38% of the plan; 1,214 hectares of foodstuff crops reached 104.66% (of which 657 ha of commercial onion purple reached 109.5% and onion seed 53 hectares to 106%). Harvested area 1277 hectares, accounting for 98.91%. Total production of 24 186 tonnes to 105.61% targets include: Food crops 77 ha, yeild 18 tons / ha quantity 1,386 tons; Foodstuff crops 1200 hectares, yeild 19 tons / ha, quantity 22,800 tons (Of which: Onion Purple 657 hectares, yield 17 tons / ha, output reached 120.09% and operating 11169, 53 ha seed yield 13 tonnes / ha quantity 689 tonnes to 125.3%). Over the same period increased by 3071 tonnes. 14 hectares are continuously harvested.

The area of 181 hectares of fruit trees; of which: lychee 178 hectares, annona 3 hectares harvested 8 tons and lychee have stopped harvesting 144 ha, yields 4 tons / ha, yields far 576 tons. Total production of 584 tonnes of fruit trees.

Aquaculture area was stocking is 3139 hectares / 2,981 households, reaching 112.11% targets, (of which 2,538 hectares of shrimp farming area reached 115.36% including: black tiger prawn 1,238 hectares, 1,300 hectares of shrimp. The area of 1,242 hectares, accounting losses 48.94% farming area include: black tiger prawn 636 ha, 606 ha shirmp, including: area damage has harvested 415 ha, 190 ha, black tiger prawn yield 0.25 t / ha quantity 47.5 tons, shrimp 225 ha, yield of 0.5 t / ha quantity 112.5 tonnes. The cause damage due to weather, unstable environment, seed quality not guaranteed.

Harvested 1,068 hectares 42.01% of the plan, of which 482 ha black tiger prawn yield 2 tons / ha, quantity 964 tons, 586 hectares of shrimp yield of 4 tons / ha, quantity 2344 tons. 3793 shrimp production reached 68.71% of the planned attack (Private companies Vinh Thuan 325 tons). Over the same period decreased shrimp farming area 101 hectares. Now, 228 hectares are well-developed.

Fish and other aquatic species was cultivated in 665 hectares, equivalent to 110.8% of the target of the plan, including: Area Artemia 213 hectares, equivalent to 213% of the plan, 10 475 kg of egg cell production monitoring, increase over 7025 kg same period. On average 1 to 1.1 millionVNĐ / Kg. Area of fishes and other aquatic 452 hectares and production of 2,024 tons, reaching 146.66% of the plan include: fish of all kinds 152 hectares, yield 13 tons / ha, quantity 1,976 tons, 300 hectares of natural fish yield 0.16 t / ha, quantity 48 tons. Aquaculture production 5857 tons, reaching 84.88%. Sea mining 960 tonnes reaching 101%. Total production of 6817 tonnes of seafood reaching 86.8% of the plan. Estimated total production of seafood products reached 90% by the end of the plan.

On livestock cattle and poultry: 2,305 pigs, 100.2% of the plan; 179 cows, reaching 81.36% of the plan; 25,500 poultry, reaching 102% of the plan.

Agriculture extension: From the beginning of this year has trained 15 class scientific and technical transfer about crop and shrimp has 890 visitors expected.

Strengthen and improve the quality of the 02 cooperatives reached 100% target

- Manufacturing Industry - Handicraft

Industrial production value-craft performed 35.6 billion, reaching 101.71% targets, (constant 2010) with some items such as ice 20 100 tonnes reaching 100.5 %, welding mechanical means 1.6 billion, reaching 106.66%, salt 860 tonnes reaching 172%, 220 tonnes of milled rice, reaching 110% and preliminarily processed Artemia eggs.

Installation of new galvanometer 141 households, reached 131 households, bringing the total number of 5867/6139 households, the proportion of

households with electricity use reached 95.56% of the total households (of which: 3,348 Khmer households).

2.2.1.2 Cultural - social

Poverty alleviation: The number of poor households ward 849 households accounted for 15.46%,620 nearpoor households accounting for 11.29%, make a list of 255 registered households poverty. Review results with 366 households out of poverty reached 178.53% of the plan, in which the poor 183 and near-poor 183 households. Establish a list of support for the poor by Decision 102 have 3,883 people with 310.640.000VNĐ

Mobilizing students to grade school year 2017-2018 is 4764 students reaching 104.35% of the plan in which: Nursery and preschool 869 reached 112.12% (including 43 nursery children reached 107.5% 826 preschool children reached 113.15%) 2,181 primary students reached 100.04%, secondary level students 1,515 reached 99.67%, 199 high school students reached 99.5%. (From the year 2016 to 2017 increased by 347 students). Secondary education establishments 111 people reaching 158.57%, primary 14 people reached 140%, eliminate the illiteracy from 15-60 years of age have 26 people reached 104% of plan targets, the proportion of wards education 100% of the plan. Results in 2018-2019 school year to the date 30.09.2018 campuses to mobilize students to class as follows: Total 4510/4520 reached 99.77% students, of which 741 nursery school birth reached 90.36% including 37 nursery children reached 92.05%, 704 preschool children reached 90.25%, primary school 2085 students reached 95.56%, junior school 1,414 students reaches 93.02%, 270 high school students. Over the same peroid decrease of 255 students.

On health: health care for the People were 12,844 arrivals: Which inpatient examination 56 people, outpatient 12,788 people, separate examination at Community 4635 people, explore treatment card health insurance 12 844 people, the amount 665.547.233VNĐ, 02 rounds to kill mosquito larva was 5.560 reached 98.7%, from the beginning of the year happened 04 cases of HFMD, 44 cases of dengue fever, an increase of 8 cases over the same period; sanitation on health sector performed well right under the provisions of the above, the expanded immunization of children under one year of age reached 98% reduced rate of children under 5 years old malnourished 9.30% reached 100 %, further recognized standard review of national criteria on health 93.5 / 100 points.

Vocational sector (including private) from the beginning of this year reached 63.61% was 229 people, plan to create jobs for 1,538 workers who reached 341.77% of the plan, labor export 9 people reached 45% plan.

Implementation of environmental indicators currently has 6139 households using hygienic water reaches 100%, households using clean water up to 65%. For production and business establishments to ensure environmental rate of 95%, the rate of collection and treatment of solid waste center at ward 100% to 123.5% compared with the norm, the proportion treat solid waste in public health facilities to reach 100% of the plan.

2.2.2 Economic conditions - social Ward 1

2.2.2.1 The economic situation

➢ Economic development in many sectors

At present, Ward 1 has 423 industrial establishments, handicraft and commercial services increased 15 basis over the same period (according to management up the 2018 Ward 1). Of which: Handicraft 06 establishments, service 61 establishments, eating 81 establishments, small businesses 172 establishments, commercial large 103 basis, the total flow of goods sold and sales services social consumption was 4.460 billion implementation achieved 107.73% against the target (+ 6.43%). The total output value of industrial-handicraft 244.5 billion achieved (calculated at constant prices 2010) reached 111.14% Resolution (up 8.11%) with industry primarily as pickled radish, ice, water bottle, noodles, welding means, mechanical, machining items serve agricultural production and materials for civil construction and preliminary processing of vegetables , fruit, candies, soy sauce, dried fish, ... Number of households with new electric meter in 134 households, of which Khmer households 8 households. Percentage of households using electricity locality Ward 100% compared to the number of households

➢ On building economic cooperation:

+ Activities of People's Credit Fund Vinh Chau achieve more efficient and meet the demand for loans among people. Results: Loan sales from the beginning of the year was 117.833 billion; Sales revenues 117.186 billion; Total loans 114.814 billion, 1.872 billion delinquency percentage 1.63% / total loans.

+ Activities of trade unions: Union Passenger motorbikes (69 members) and Union caught seafood (88 members) that works efficiently and stable income.

+ Results of operations of six cooperative groups in 2018 were evaluated and graded 02 well-functioning teams, 02 average operating teams, 01 weak operation team and 01 stop working group.

Agricultural production situation:

Rice: Farmers sowing, transplanting is 41ha 102.5% Resolution, mainly rice OM 6976 and ST5. Rice sowing area damaged by flooding is 4ha / 14households (up 1,59ha over the same period, has to fix the damaged area). Harvested rice area of 41 ha, the average yield of 5 tons / ha, quantity 215 tonnes to 107.5% Resolution.

Fruit: Fruit Area harvested 18ha 90% Resolution, yield 16tons / ha, quantity 48tan (3ha decrease over the same period). The area of fruit trees damaged by the typhoon is mainly lychee 2ha.

Crops: Area crop is 377 hectares implement 114.24% Resolution, the average yield of 19.76 t / ha, quantity 7,452 tonnes to 125% Resolution (with detailed annexes attached).

Breed: Total cattle perform 1,551, reaching 138.48% Resolution (Among them: the 1,400 pigs reached 140% Resolution, the 151 cows reached 125.83%

Resolution). The poultry population is 11.140 achieve implementation 111.40% Resolution. 5459 were slaughtered was accounted 43.01% Total Forum (of which: 4814 poultry, pigs 618 , cows 27).

Fisheries: Area aquaculture 453ha / 593households reached 113.25% Resolution 49ha decrease over the same period (of which: prawn 121ha / 163 households reached 121% Resolution; shrimp 232ha / 305ho achieve 116% Resolution; fish and other aquatic 100ha / 125 households 100% Resolution). Harvested area 382ha / 520 households (Of which: Shrimp 200ha / 283 households yield of 5.5 t / ha quantity 1.100tan; prawn 82ha / 112 households yield 3 tons / ha quantity 246 tons, all kinds of fish 100ha / 125 households (of which: snakehead 10ha / 13 households, average 150tons yield / ha quantity1,500 tons, all kinds of fish 90ha / 112 households, the average yield of 2 tons/ ha quantity180 tons).

Damaged area harvested 71ha / 73 households (up 71ha / 73 households over the same period) in which the 39 hectare black tiger prawn / 51households; shrimp 32ha / 22 households quantity 71 tons.

Outturn sea fisheries exploitation, domestic operators perform 990 tonnes to 104.2% Resolution. The total output of aquatic products achieved 4.016tons, reaching 177.7% Resolution.

2.2.2.2 Cultural - social

➢ **Education Department:**

Last school year 2017 - 2018 the number of students at all educational levels also 5079 / 6.425 students. Of which: 1211 preschool children increased 26 children, 2,230 primary school children dropped by 30 students, 1,638 middle school children dropped by 43 students compared to the school year. Test results completed by 1,248 students learning levels. Including: completion of preschool students are 100% 470/470, 443/446 primary school students reached 99.33%, junior high school level reached 99.7% 335/336 students.

Grade student athletes to the school year 2018 - 2019 is 5,380 / 5,120 students, at 105.1% Resolution and small town plan.Including: The preschoolers 1.112 / 1.190 students, reaching 93.45% Resolution; Primary level 2,558 / 2,280 students, reaching 112.19% Resolution; Junior secondary level 1,710 / 1,650 students, reached 103.64%. Provision 2018-2019 school year at campuses in ward 1, 2000 notebooks and issued 16,000,000VNĐ for students to overcome poverty in the Primary School 1,2,3, campaign funding from sponsors. Coordination with the Study Promotion Association, the steering committee of the border guards Vinh Chau handed 21 scholarships "Raising step children to school" each worth 1,000,000 VND for poor students overcome difficulties at some school on Ward 1.

Primary education establishments 10 peoples reached 100% Resolution, junior high school level 40 people reached 133.33% Resolution and Eiminate the illiteracy from 15-60 years of age is 15 reached 100% Resolution.

➢ **Health, Population and family planning work of the Red Cross:**

Examination and treatment at the station is 4310 turns; Check health insurance: 2702 turns; Children under 6 years of age receive health care: 84 turns; Oriental Medicine Clinic: 1,083 turns.

Food safety: Coordinate with relevant test 15 basis trading, manufacturing business during the Lunar New Year, Mid-Autumn Festival and Ceremony SenDolta 2018 general facilities are hygienic quality and food safety for consumers as stipulated. Make good inspection food safety in catering establishments where refreshments 138 base; 105 street shop, sanitation 1786 turns. In general, the base sales and business production are ensure quality hygiene and food safety for consumers as stipulated.

Prevention of infectious diseases in humans: epidemic of dengue fever cases detected 16 cases (down 03 cases over the same period), HFMD 12 cases (07 cases increase over the same period); Vaccinating 1,157 children turns.

People's Committee of Ward 1 Council has proposed evaluation criteria for National Health, Vinh Chau town to organize the revision, evaluation and recognition ward 1 reached Criterion National Health 2018

CHAPTER 3 ASSESSMENT, FORECASTING ENVIRONMENTAL IMPACT OF PROJECT

3.1 Assessment, forecasting impact

3.1.1 Assessment, forecasting impact in the pre-construction phase

The environmental impacts caused by the project are summarized in the following table:

Table 3.1. Impacts in the pre-construction phase

No.	Source	Impact	Impacted objects	Impact Level	Position of impact
A	**Impacted Objects related to waste**				
	Solid waste				
	Land acquisition and clearance	Chopping trees during clearing process	Local people	Low	Within the project area
B	**Impacted Objects unrelated to waste**				
1	Selecting the project location	The impact on local people and their economic.	Affected peoples	Low	within the project area
2	Acquisition	Changing land using purpose The permanent required Affecting to daily and working activities	Social Economy Biological Resource, Biodiversity	Low	within the project area

3.1.1.1 Impacted objects related to waste

In the pre-construction phase, land clearance is mainly done by primitive means and manual labors so there are virtually no emissions, wastewater and hazardous waste which can affect the surrounding environment.

Therefore, impacts in this phase is quite low and could be controlled.

Crops affected by the project

In the process of preparation for construction, it is expected to cut about 15 longan trees and 30 mixed trees.

Therefore, the impact of the project in this period is very small and can be controlled.

3.1.1.2 Impacted objects unrelated to waste

(1) Selecting project location assessment

Selected project location belong to Vinh Phuoc Ward, Ward 1 - Vinh Chau Town – Soc Trang Province district where possess high potential of wind energy and satisfy the following requirements:

- Regional wind potential, project implementation layout
- Topographical and geological conditions of the area
- Regional transportation conditions
- Connection ability to the power grid
- The compatibility with the development planning
- Not affect residential areas
- To satisfy the requirements for national defense.
- There are favorable conditions to the next development stage.

(2) Clearance impacts

In the process of implementing site clearance of the Company, there are specific advantages and disadvantages:

- Advantage:

+ Good support from local authorities at all levels;

+ High consensus of people affected by the project.

- Hard:

+ The project owner does not have much experience in compensation, so it is unavoidable;

+ In the beginning, there were some difficulties in preparing compensation documents for the project.

The clearance in the preparation phase of the project may cause the following effects:

- Reducing the ability to use land under the power grid safety corridor.

- Impact on socio-economic activities of people in the project area.

The number surveyed at the time of the preliminary survey (February 2019) will be accurate in the period of measurement and detailed inventory after demarcation and cadastral mapping.According preliminary investigation result for design project, quantity compensation and premises clearance of project as follows:

1) Affected land

1.1. Impact on permanent land acquisition

According to the survey results and the inventory of losses in the Investment Project.

The fixed-term land acquisition of the project will make land use purpose change to become the specialized land. The temporary land acquisition during the construction phase and the safety corridor of the transmission line route will change the local land use situation. Statistics of land affected by the project are presented in the following table.

Table 3.2. Area of land for a fixed-term period

No.	Items	Area (ha)
1	Aquaculture land	9.522
2	Land annual trees	0.508
3	Land perennial trees	0.190
	Total	**10.220**

Besides, the project does not need to hire land of people to make temporary storage to excuse the work, the contractor will make use of the erection yards at the foot of the turbine to construct these temporary storage facilities.

1.2. Land is limited in use due to underlying ROW of the connected line:

Decree No. 14/2014/ND-CP dated 26/02/2014 of the Government stipulated the ROW of the overhead line as follows:

- The width of the ROW limited by two vertical planes to the two sides of the line, parallel to the line, the distance from the outer wire to each side when the wire is stationary is 4m (for 110kV grid).
- The height of the ROW calculated from the bottom of transmission line to the highest point of the facilities is more 4m (for the 110kV grid).

Table 3.3. Land is limited in use due to underlying ROW

No.	Items	Unit	Vinh Phuoc ward	Ward 1	Total
1	Land perennial trees	m^2	5,457.9	1,364.5	6,822.4
2	Land annual trees	m^2	5,816.6	-	5,816.6
	Total	m^2	**11,274.5**	**1,364.5**	**12,639.0**

1.3. Land is temporarily affected during construction

In the process of construction, about 1.345 ha of aquaculture land of households were hired.

2) Affected houses

2.1 Housing / structure is affected by being located under the safety corridor of the 110kV line

No.	Items	Vinh Phuoc Ward		Ward 1		Total	
		Amount	Area (m^2)	Amount	Area (m^2)	Amount	Area (m^2)
1	Tomb	-	-	2	11,56	**2**	**11,56**
2	Thatched roofs house	7	103,2	2	57,83	**9**	**161,1**
3	Warehouse	-	-	2	2.775	**2**	**2.775**
4	Kitchen	1	11	-	-	**1**	**11**
5	House level 4	1	160	-	-	**1**	**160**
Total		**9**	**274,2**	**6**	**2844,39**	**15**	**3118,66**

Table 3.1. Housing and structure under the safety corridor of the 110kV line

2.2 In the project area, there are no houses or structures expected to be relocated.

Affected trees

Some crops are cut off are longan, vegetables, and Grass

3) Impact on the social economic environment

Social economic activity of the local people affected by the project is not great because population density living in the project area is sparse, the majority of people living in the project area are Kinh, Hoa, Khome... with agriculture as the main occupation.

However, the project owner and the local authorities will also take great care and have the appropriate support policy to stabilize life and production of the households affected by the project.

Therefore, the project owner and local authorities will also pay much attention and have appropriate support policies to stabilize the life and production of the households affected by the project.

Table 3.5. Total households affected

Impact	Households	People	Infulence level
Total	183	755	
1. Households whose land is acquired by the project:	56	230	- Households whose land is acquiredfor turbine foundation22 / 110kV of power plant 3, and foundation poles. - The project owner will compensate for the acquired land in accordance with current regulations and the compensation

Impact	Households	People	Infulence level
			will be completed before carrying out clearance activities. - For households who lose much agricultural land and the remaining land is not enough to cultivate, people will be supported to change their careers.
2. Households have residential land and agricultural land located in the safety corridor of the line	127	525	- Residential and agricultural land of households under the safety corridor of the line will be affected by the reduction of utility (only planting trees and building houses with the height must ensure safe distance according Decree 14/2014 / ND-CP on February 26, 2014). - This land is not recovered. - The project owner will support this affected land according to regulations (maximum 70% of compensation price).
3. Households and structure under the power grid safety corridor (8m from the center line to the two sides) need to be renovated or grounded.	15	58	- Houses / structures under the safety corridor of the line must be renovated or grounded to ensure safety and survival as prescribed in Decree 14/2014 / ND-CP on February 26, 2014). - This house / structure is not relocated. - Households may be affected in daily life. - The project owner will support the cost of renovation, roofing and support due to the reduction of usability as well as the impact of living with regulations (maximum 80% of the value of houses / structures).
4. Households with crops are expected to be cut off	10	43	The project owner will compensate for crops that are cut down in accordance with current regulations and compensation will be completed before carrying out clearance activities.

Impact	Households	People	Infulence level
5. Households rent land to make temporary construction sites, , foudry yards, ...	12	52	- The project owner pays land rent during the temporary use period. - Project owners pay for crops if they damage the people. - The project owner is responsible for clearing the site, returning the land and returning it to the people as the original purpose.

Remarks and assessments:

The construction of the project will: Take up to 101,460 m^2 of land to build turbine towers, internal roads, transformer stations, operators and lines.

The project owner will coordinate with the Local Compensation Board to implement the compensation and support policies for affected households. The compensation and support framework approved by Soc Trang Provincial People's Committee based on the recommendation of the Compensation Board.

Compensation and support for affected households is completed by to build the project.

Estimated total cost of compensation and support for households is estimated at VND 10.8185 billion. Compensation and support for affected households is completed before the project construction.

In summary, the project has certain impacts on local households. All land, crops and assets on the land affected by the project are compensated by the Project Owner in accordance with the current regulations with the unit price submitted by the Compensation Council to the Provincial People's Committee for approval. The project can be minimized as possible.

3.1.2 Assessment, forecasting impact in the construction phase

The environmental impacts caused by the project are summarized in the following table:

Table 3.6. Impact of project on construction phase

No.	Source	Impact	Impacted objects	Impact Level	Position of impact
A	**Impact source and Impacted objects and Level related to waste**				
1	***Dust, emission***				
1.1	Excavation and filling 6,035m^3	Dust: - In the turbine area: 0.083mg/m^3	- Labors - Local people	Medium	In the construction positions of foundations

No.	Source	Impact	Impacted objects	Impact Level	Position of impact
		- In the 110kV substation area: 1,551mg/m^3			for turbines, towers and position of substation
1.2	Operation of construction machinery and material transport vehicles	Dust- transporting concrete: 0.39g/s - Transporting sand, stone: 0.4g/s NOx: 0,001-0,023mg/m^3 SO2: 0,02-0,3mg/m^3 CO: 0,2-3mg/m^3	- Labors - Local people	Low	At construction area and along the transportation route
2	***Liquid Waste***				
	Daily activities of construction workers (100 persons)	Domestic wastewater: 9.6 m^3/day	- Surface water - Underground water	Low	In the construction sites
3	***Solid waste***				
3.1	Daily activities of construction workers (100 persons)	Domestic solid waste: 25-30kgs/day	-Soil environment -Air environment -Natural landscape	Low	In the construction sites
3.2	Construction items for erecting turbines, substations, connection lines and working rooms	- Construction solid waste: 100kgs/daily	-Soil environment -Air Environment - Workers	Low	In the construction sites
3.3	Hazardous waste	Hazardous waste: 5-6kgs/month	- Soil environment	Low	In the construction sites
B	**Impact source unrelated to waste**				
1	Transportation of equipment, machinery and raw materials	- Increasing pressure on public transport systems: - Increase the density of vehicles in traffic - Increase risk of causing damage, surface subsidence,	South Hau River Road and local roads.	Low	South Hau River Road and local roads.

No.	Source	Impact	Impacted objects	Impact Level	Position of impact
		etc. (when transportation of equipment, machinery and raw materials overloaded, oversized, etc.) - Dust can affect water quality of shrimp ponds around transport routes.			
2	Installing turbines, steel towers and stretching cables, road operation	- Noise <70dBA	- Labors - Local people	Medium	In the construction sites
		- Erosion	- Changing land use purpose - Surface water	Low	In the construction sites
3	Pull, stretch the wires	Cutting down trees in ROW	Ecological environment (natural vegetation)	Medium	In the ROW of the whole internal lines and connection lines
4	Gathering workers (100 persons in the peak period).	- Immigration - Spreading disease - Conflict between construction workers and local people - Fire hazard, vibration	- Soil environment - Water Environment - Natural landscape - Public Health	Medium	In the construction sites
5	Risks, incidents	- Working accidents; - Fire, explosion	- Labours	Low	In the construction sites

3.1.2.1 Impact source related waste

(1) Impact on air

In the construction phase, the ambient air quality in the project area will be impacted by transportation means, construction equipment, earthworking, and transportation of construction material. Major pollutants are dust, exhaust fume with CO, SOx, NOx, Hydrocacbon.

❖ *Dust:*

During the construction phase, the following main activities will create dust to impact on the air environment such as (i) earthworking, backfilling for tower

foundations and turbine foundations, access roads and substation of the project; (ii) transportation, loading and unloading construction material and machineries.

The concentration of dust generated varies and depends on intensity of activities, micro-climate conditions, weather and soil characteristics. These activities will not occur continuously and concentration of building is not intense, include:

- Dust is arisen from earthworking activities due to construction of the project items.
- Earthworking activities for the project construction items are the main generation source of dust affecting the air environmental quality.
- Dust is arisen from transport activities and process of loading and unloading construction materials (cement, soil, sand, stone, etc.), and machineries. In addition, when to the gathering place, the construction materials dumped off from a vehicle can create dust to impact on construction workers' health and the surrounding environment.

Table 3.7. Total volume of digging and filling

N	Item	Unit	Volume
1	Digging	m^3	5,981.0
2	Cover foundation hole	m^3	7,511.61
Total		**m^3**	**13,492.6**

Source: Feasibility Study, PECC3, March 2019

The amount of soil excavated will be used for leveling tower foundations and surrounding them. Therefore, the amount of backfill soil is almost equal to the excavated soil.

The work of excavation, piling, erecting poles at each foundation position lasts up to one month and is divided into several stages. Each stage lasts about 1-2 weeks (excavation, casting foundation, erecting poles), construction time is not long, construction sites of wind turbines distribute throughout the project area; the 110kV transmission line is nearly 5.8km long, the 22kV transmission line is 80m, system of internal roads have length of 8.119km.

Dust emission coefficients due to excavation, levelling, loading and transport is shown in the following table:

Table 3.8. Dust emission coefficients

No.	Cause of pollution	Estimated emission coefficient
1	Dust due to excavation and levelling activities and wind blowing (sand dust)	1 ÷ 100 g/m^3
2	Dust due to loading and unloading activities of construction materials (cement, soil, sand, stone...) and machines, equipments.	0,1 ÷ 1g/m^3
3	Exhaust fume of transportation and execution means with dust, CO, hydrocarbon, SO2, NOx, etc. (lorry 3,5 – 16 tons, DO with S=0,5%)	Dust: 4.3 kgs/ton DO, SO_2: 0.1 kg/ton DO, NO_x: 55 kgs/ton DO, CO: 28 kgs/ton DO, VOC: 12 kgs/ton DO
4	Sand and soil scattered during material transportation process which can cause dust	0,1 ÷ 1g/m^3

Source: Rapid assessment guide of WHO

Calculating dust emission during the construction process at the items as follows:

The affected area estimated is 3 times of the length of each side of the foundation pit area and substation area, thus the affected area is 9 times of the permanently required land area by the project and the emission height of 5m, the affected space can be computed as follows:

No.	Item	Unit	Amount	Affected area (m^2)	Affected space (m^3)
1	Wind turbine and the 22kV internal transmission line	turbine	7	28,875	1,299,375
2	110kV substation and working rooms	station	1	17,500	787,500

- According to the rapid assessment document, the amount of dust generated by digging and leveling would be blown up about 100g/m^3 soil. The time of digging, filling and construction is approximately 01 month. With the affected area calculated above, the average dust concentration per hour can be computed as follows:

No.	Item	Construction time (month)	Explanation	Average dust concentration per hour (mg/m^3)
1	Wind turbine and the 22kV internal transmission line	1	3,103m^3 x 100g/m^3/(1,299,375m^3 x 1month x30 days x 8h x 12 turbines)	0.083
2	110kV substation and working rooms	1	2,932m^3 x 100g/m^3/(787,500m^3 x 1month x30 days x 8h)	1,551

Thus, only the average dust concentration generated for 1 hour during the construction process at the locations of the 110kV substation and working rooms is 1.551 mg/m^3 higher than the average limited concentration for 1 hour as 0.3 mg/m^3 according to QCVN 05:2013/BTNMT.

Dust volume arisen from transportation and loading and unloading construction materials:

According to a number of domestic and foreign documents (Handbook of Emission, Non-industrial and Industrial sources, Netherlands; Air Environment, 1997 - Pham Ngoc Dang), when passing the 1,000 km distance, light vehicles (weight category < 3.5 tons) usually create 0.2 kg of dust; heavy vehicles (3.5 ÷ 16 tons) generate 0.9 kg of dust (ie: 0.9g/km).

Volume of transport and transport distance are as follows:

Equipment and supplies: transport distance from Cai Cui Port to Vinh Phuoc, Vinh Chau town is 110 km.

Sand, stone, cement, steel will be taken in the local area. Transport distance of these materials to the construction site is 20km, material transportation by motorized means, main traffic road is National Highway 1A and Highway DT702.

Table 3.9. Volume of transport and transport distance

No.	Categories	Quantity (m^3)	Distance (km)
1	**Sand, stone in sizes**	**800**	**20**
2	**Concrete grade 100**	**56**	**20**
3	**Concrete grade 200**	**122**	**20**
4	**Concrete grade 300**	**603**	**20**

Source: Feasibility study, PECC3, October 2013

- Estimated number of vehicles transporting materials (15 ton loading capacity):
  - ❖ Transport concrete:
    - (781 x 1.5) tons/15 tons = 78 trucks
  - ❖ Transport sand, rock:
    - (800 x 1.5) tons/15 tons = 80 trucks
- Estimated amount of dust generated by vehicles with maximum pollution load for 1hour can be predicted as follows:
  - ❖ Transport concrete:

  0.9g/km x 20km x 78 truck/3,600 = 0.39g/s

❖ Transport sand. rock:

0.9g/km x 20km x 80 truck/3,600 = 0.4g/s

Generated dust concentration may affect the workers' health and the environmental quality in the project area. The problem of dust due to transporting materials to the construction sites via the pathways will also be paid attention and minimized. This effect is only temporary, not continuous along the length of the route and will end when construction is finished. In addition, the project area is far from the residential area so this effect is insignificant.

Calculation results show that the dust concentration in the construction site is higher than QCVN 05:2013/BTNMT (0.3mg/m^3), therefore dust affects the health of workers and environmental quality in the project area. Therefore the project have to apply mitigation measures in Chapter 4 and this effect only occurs during earthworking, transportation, loading and unloading materials and terminates when construction is finished.

❖ *Exhaust gas:*

Operation of vehicle and construction machinery arises exhaust gas to the air environment including:

- Welding fume;
- Emission smoke from transport means, construction machinery contains dust, CO, hydrocarbon, SO_2, NOx, etc. The construction means mainly comprise excavators of 3m^3, dump trucks of 10 tons, etc.
- During the construction process, the project can use a backup generator, so this would be a source of air pollution. The air pollutants include SO_2, NOx, CO, dust, VOC, etc

Exhaust gases are primarily arisen from the transportation means during the construction process. According to the Feasibility study in March 2018, at the project construction site there are 80 vehicles, average transport distance is 5km/vehicle.hour, maximum number of operation hours is 8 hours/daily. Thus the air pollution amount due to the exhaust gases can be predicted for each type of vehicles are as follows:

Table 3.10. Coefficient of air pollution dispersion corresponding with type of vehicle

Type of vehicle	SO_2 (kg/U)	NO_x (kg/U)	CO (kg/U)	VOC
Heavy lorry, diesel engine from 3.5 to16 tons				
Emission coefficient	4.29S	11.8	6	2.6
Emission amount (g/s. vehicle)	0.05	0.13	0.07	0.03

Source: Rapid assessment guide of WHO

Note: S – Percent of Sulphur in oil fuel, S = 0.2% ÷ 0.5%.

Based on emission coefficients in table 3.9 and number of vehicles, concentration of pollutants in exhaust gas is calculated according to Berliand method at point of 10m from the road as follows:

$$C_{L(K)} = \frac{10^3.\eta.M.B}{\sqrt{\pi}.\sigma_z.u.x^{1-n/2}}.e^{-H^2/C_z^2.x^{2-n}}$$

Where:

M – Unit mass of pollutant of road source, g/s.m

H – height of road source compared with the ground surface, H = 1m

x, y – Coordinates; x=10m and y=0

u – Wind velocity, m/s

σ_y, σ_z – Diffusion coefficients according to horizontal and vertical directions, in the normal condition $\sigma_y = \sigma_z = 0.05$

n – Coefficient involved in change of climate condition, temperature corresponding with height. For road source with a low height, n = 0

B – Coefficient is calculated from the following formula:

$$B = \text{erf}\left(\frac{y+\frac{L}{2}}{\sigma_y.x^{1-n/2}}\right) - erf\left(\frac{y-\frac{L}{2}}{\sigma_y.x^{1-n/2}}\right)$$

η - Coefficient is based on time of measuring environmental parameters

$$\eta = 1 + \frac{5-\Delta\tau}{2.\Delta\tau^{0,9}}$$

$$\eta = 1 + \frac{5-\Delta\tau}{2.\Delta\tau^{0,9}}$$

$\Delta\tau$ - Sampling time, NO_x and SO_2 : $\Delta\tau$ = 20 minutes

CO : $\Delta\tau$ = 5 minutes

Calculation result is as follows:

Table 3.11. Concentration of pollutants in the areas

Area	Number of vehicles used in the area	SO_2 (mg/m^3)	NO_x (mg/m^3)	CO (mg/m^3)
Transportation sections in the region	80	0.09÷0.3	0.0067÷0.153	1.33÷20
QCVN 05:2013/BTNMT (average one hour)		0.35	0.2	30

Impacts on the air environmental quality due to emission gases such as NO_x, SO_2, CO, etc. from construction activities are locally impacts (within construction and surrounding areas). Data measured shows that all emission gases are in allowable limits compared with QCVN 05:2013/BTNMT. Thus, the impacts mainly affect workers' health and only occur in the construction phase.

Air pollution and dust caused during the construction process will impact on health of the construction workers, especially diseases related respiratory system. However, the construction time is short, the effects on workers and local people is insignificant, so there is no impact on the ecosystem in the project area.

(2) Impact on the water environment

❖ ***Domestic wastewater***

Sources of wastewater generated in the construction process of the project are mainly domestic wastewater of the construction workers (in the peak period of about 100 workers).

The number of construction workers at each location depending on the construction phase and construction means: digging, backfilling and concreting (5 ÷ 7 persons/ foundation dependent on using hands or mechanical vehicles for excavation); fastening steel, erecting steel tower (5 ÷ 10 persons/foundation). The construction distributes over the project area and does not concentrate in one place. Construction time generally takes place approximately 15-20 days for a foundation.

According to the Construction standard 33-2006 of the Ministry of Construction, supplied water for 1 person is 120 litters/person/day. The amount of domestic wastewater of 1 people is estimated as 80% of the amount of supplied water.

At the peak period, there are 100 labourers every day, thus the amount of domestic wastewater in the construction phase of the project is calculated as follows:

100 persons x 120 liters/person/day x 80% = 9.6 m^3/day

Therefore, volume of domestic wastewater generated at the project area is about 9.6 m^3/day.

Components of domestic wastewater include suspended matters, grease, high concentration of organic matters, sediments, dissolved organic matters (via criterion such as BOD_5, COD), nutriments (Nitrogen, Phosphor) and micro-organism. The characteristics of domestic wastewater are presented in the following table:

Table 3.12. Domestic wastewater

No.	Parameters	Pollution factor of WHO (g/person.day)	Volume (kg/day)
1	BOD_5	45 - 54	2,5-3
2	COD	72 - 102	4-5,6
3	SS	70 - 145	3,9-8
4	Grease	10 - 30	0,6-1,7
5	Total N	6 - 12	0,1 - 0,2
6	Amôni (N-NH_4)	2,4 - 4,8	0,3-0,7
7	Total P	0,8 - 4,0	0,04-0,22
8	Coliform (MNP/100ml)	10^6 - 10^9	10^6 - 10^9

Sources: Wastewater treatment, Hoang Hue

Table 3.13. Concentration of pollutants in domestic wastewater

No.	Parameter	Unit	Concentration of pollutant	QCVN 14:2008/BTNMT (cột B)
			Untreated	
1	pH	mg/l	5-9	5-9
2	BOD_5	mg/l	450-540	50
3	SS	mg/l	700-1.450	100
4	Nitrat (NO_3^-)	mg/l	50-100	50
5	Total coliform	MPN/10ml	10^6-10^9	5.000

Sources: Wastewater treatment, Hoang Hue

Note: Column B - Domestic wastewater discharging into water sources is unused for domestic purposes.

Remark:

So, quality of domestic wastewater exceeds permitted standards (QCVN 14:2008/BTNMT, column B) if not treated it can cause deterioration of river water quality.

❖ Construction wastewater

During the construction process, the project only needs to use water to mix concrete, this water use is very little and does not arise out. Therefore, the impact of wastewater on the environment is not available.

❖ Overflow rainwater

Rainwater overflowing through the construction sites sweeps mud, oil and other contaminants, that is a pollution source which increases turbidity at neighboring rivers and channels.

According to TCXDVN 51: 2008, the calculated flow of stormwater runoff through the project area (mainly in the rainy season) is determined by the method of limit strength and calculated by the following formula:

$$Q = q.C.F \text{ (l/s)}$$

q: Rainfall intensity calculated l/s.ha;

C: Average flow coefficient

F: Area of water collection (ha).

$$Q = 0{,}278.10^{-3}.I.\ C.f \text{ (l/s) mm/h x m}$$

Includes:

$0{,}278.10^{-3}$: Unit conversion factor

I: The intensity of rain is highest in 1 hour, I = 43 mm/h (~ 0,012 mm/s) (Soc Trang area)

C: Average flow coefficient, ground C = 0,46 (calculated on the surface with a small slope of 2-7%)

f: Area (m^2)

Project area 10,201ha = 102.010m^2:

$$Q = 0{,}278.10^{-3} \text{ x } 0{,}012 \text{ x } 0{,}46 \text{ x } 102.010 = 0{,}156 \text{ l/s.}$$

***(3)* Impact due to solid waste generated**

Solid waste generated during the construction phase includes construction waste and domestic solid waste of labors.

Excess soil due to excavation and embankment: as described in Chapter 1 about calculation of earthworks, volume of materials needed to level the station and

fill the pit is much higher than the amount of excavated soil. All excavated soil will be used to fill, fill the pit and level the base. Therefore, the project does not generate excess land due to construction and excavation. The lack of materials for leveling will be purchased by the project owner in the local area.

The project owner commits to comply with the provisions of Directive No. 04 / CT-UBND dated 10 April 2018 of the Chairman of the Provincial People's Committee on strengthening management of land exploitation activities for construction materials. usually in Soc Trang province.

❖ Construction waste:

Consists of construction material refuse such as scrap-iron, scrap-steel, brick, stone, cement, etc. This quantity of waste is estimated approximately 100kgs per day. This waste will be not discharged into the environment but reused to backfill (brick, stone, etc.) or reused, or sold to scrap dealers (scrap-iron, scrap-steel, etc.).

❖ Domestic solid waste:

Centralization of construction workers during a long period will generate a big quantity of domestic solid waste from 25 – 30 kgs/day (estimated average from 0.25 to 0.35kg/person/day x 100 workers). Main components of domestic solid waste include:

- Compounds originate from organic matters such as vegetables, leftover food, etc.;
- Kinds of packages, food and drink wraps, etc.;
- Inorganic compounds such as plastic, glass, etc.;
- Metal such as food cans, etc.

Every day, domestic solid waste is collected, concentrated and sorted at the waste collection area.

❖ Hazardous waste

Hazardous solid waste includes: greasy rags, oil tanks ... not much (about 18-25 kg / month) depending on the situation at the construction site) during the construction process;

Table 3.14. Hazardous waste on the site

No.	Type	Hazardous waste code	Volume (kg/month)
1	Wipers stained with grease and oil cans	180201	3- 5
2	Welding rod waste	070401	15-20

No.	Type	Hazardous waste code	Volume (kg/month)
	Total		**18-25**

Welded rods are calculated based on the unit diameter of the rebar that the project builds, according to Official Letter 1778 / BXD-VP dated August 16, 2007 of the Ministry of Construction Regarding the announcement of the estimated cost of repairing works build.

All potentially hazardous wastes will be collected, classified and stored in containers with lids, labeled and put in a safe place at the site.

3.1.2.2 Impacted objects unrelated to waste

(1) Impacts due to noise and vibration

In the construction process, the main source of vibration arises from construction machinery and heavy trucks transporting raw materials. Heavy trucks can generate vibration and affect houses along the transportation route of materials. However, because maximum number of trucks used is 30 cars, so the impact of vibration generated by vehicles is considered medium.

During the project construction phase, noise pollution can be caused by:

- Due to the feature of the construction work of the project, pile foundations should be reinforced firmly so noise and vibration arisen from the equipment is quite high.

- The equipment, construction machinery (bulldozers, concrete mixers, excavators, compressors etc.).

- Vehicles transport raw materials and equipment.

Referring some technical documents, noise from some means and machines as follows:

Table 3.15. Noise level of machines, vehicles

No.	Machine	Noise level at distance of 1,5m (dBA)	
		Reference (1)	Reference (2)
1	Bulldozer	93	-
2	Compressor		72 - 74
3	Excavator		72 - 84
4	Truck	93	82 - 93
5	Concrete mixer	75	75 - 88
6	Pump		80 - 83
7	Crane		76 - 87

Notes:

- Reference (1): Nguyen Đinh Tuan and associates, 2007.
- Reference (2): Mackernize L.Da, 1985.

Level of impact can be estimated based on the following formula:

$$P_1 – P_2 = 20\log(D_2/D_1)$$

Where:

Pi: level of noise at the distance i^{th} (dBA)

Di: Distance from noise source to received point (m)

Maximum noise level, which is caused by horns of car/van and from operation of bulldozers, excavators, compressors, etc., at locations from the residential area to the construction site about 500m, could be calculated as below

$$P_{30} = 93 – 20 \log (500/1,5) = 42,5\text{dBA}$$

Remarks:

- Besides, location of the project is far from the resident area so impact of noise and vibration from the construction equipment is insignificant according to QCVN 26:2010/BTNMT (70 dBA). In addition, the equipment only operates during the daytime and the mitigation measures are also implemented so this impact is considered small, short term, can be controlled and minimized.
- During the construction process, the project owner will implement the mitigation measures to ensure noise and vibration lower than QCVN 26:2010/BTNMT and QCVN 27:2010/BTNMT. In case labors who have to work with the equipment creating big noise, they will be provided the protection equipment and the project owner needs applying protection measures that are proposed in chapter 4.

(2) Impact on working and daily activities of local people

- The process of build project can affect the daily life as well as may affected the agricultural production activities of people in the project area.
- However, in practice, the time of construction will be chosen after the harvest of aquatic products to reduce damage to the affected people to a minimum... In case of need to implement the project when the crop is not harvested to ensure the progress of the project, the contractor and project owner will collect damages and negotiate adequate compensation for affected people by build project.
- So this affect is considered minor and can be repair well.

(3) Impact on public transport

Transport task can affect the routes with high traffic density such as National Highway 91B, Nam Song Hau road,

- Increasing the density of vehicles on the traffic road (near the construction site)
- Increasing risk of damage, road surface subsidence, etc., (when transporting overload / oversized equipment, machines and raw material, etc.).

In the project area, there are 01 asphalt road, 2 concrete roads and 13 pathways which are difficult to travel scattered along the asphalt road and concrete roads. In addition, surrounding to the project area there are some major traffic roads including National Highway 91B.

However, this effect can be overcome by arranging the construction time and installing appropriate sign and post during construction.

(4) Impacts on military zone and historical and cultural monument

According to the project site described in Chapter 1 and the results of the field survey show that the project does not go near or cross any military zones or areas of cultural relics, history, public landscapes. Therefore, the project will not cause any effect on military areas or landscapes, monuments and protected areas.

During the construction process, if any historic or archaeological remains discovered, the project owner should report immediately to the Department of Culture, Sports and Tourism & Soc Trang province for consideration. Workers are provided the necessary knowledge to do in case archaeological remains are discovered.

(5) Impacts due to concentration of construction workers

Infectious disease can spread from construction workers to local people and vice versa in unsanitary conditions and daily contact. This impact is considered minor because there is one medical station in every commune where construction workers concentrate, moreover they are propagated prevention knowledge of infectious diseases.

Conflicts between construction workers and local inhabitants will not happen in the project area because most of the construction workers are from the local people, who have knowledge about customs and habits of the local inhabitants.

(6) Impact on other socio-economic activities

The increase in the number of workers serving the project increases local consumption and the demand for social services and facilities. The needs of

construction workers for food, daily necessities and services will lead to the rapid development of local social amenities.

(7) Impact on ecosystems

At the construction area of the substation, operator and 110KV line

Activities in the construction phase include installation of turbines and construction of other project items such as cable lines, working bridges, operators, substations, ... The above activities only disturb Mix in a relatively small area. However, these activities still affect the living environment in the area but only occur in a certain period. Other ecological impacts of the area are mainly in management (such as hunting animals, discharging waste or hazardous waste into the environment).

Domestic wastewater and organic waste are sources that directly affect aquatic ecosystems without good remedies, reducing natural oxygen and light into the water. Some types of inorganic waste such as fuel (oil, grease, etc.) that exist in water can kill organisms or plant plankton, reduce biodiversity and self-cleaning ability of the source. country. In addition, pathogens containing pathogens, containing sludge when discharged into the environment will affect aquatic species in the area, while affecting the quality of water supplied to shrimp and fish ponds of local people. area.

Fauna and flora species living on land and underwater are significantly changed in the number and diversity of species, especially the fertility phenomenon due to organic wastes from workers' activities and epidemics. Service around the project area (catering, refreshments, motels, etc.) is discharged into the surrounding canals. In addition, a number of tree species in the construction area of the substation, operator and transmission poles will be cut down during the construction process, which partly affects the biomass of the terrestrial plant ecosystem. This, combined with the noise generated from machinery and equipment, the increase in immediate population density at construction sites also makes some types of native animals residing in the construction area have to move to neighborhoods. However, because the construction area of terrestrial items is mainly aquaculture ponds, native species will not be much. This impact is local and ends when construction items are completed.

At the construction area of the turbine

Because the topography is relatively flat and has a very low average depth, plus a typical sandy bottom, the offshore ecosystem can only include the ecosystems of aquaculture species of households. . The high concentration of suspended solids in the water due to the dredging process to move, and the dredging of the turbine foundation area will limit the light shining on the water layers, affecting

the photosynthesis process of algae, seaweed moss and offensive to fish life (due to small seeds entering to choke) forced the creature to move (if possible) out of the area due to the loss of stable habitat

When constructing wind turbines, construction equipment and means of transport will cause water shock in a fixed area at the construction site (<1000m^2 of water surface / time), especially work. pile driving, pile driving at turbine foundations.

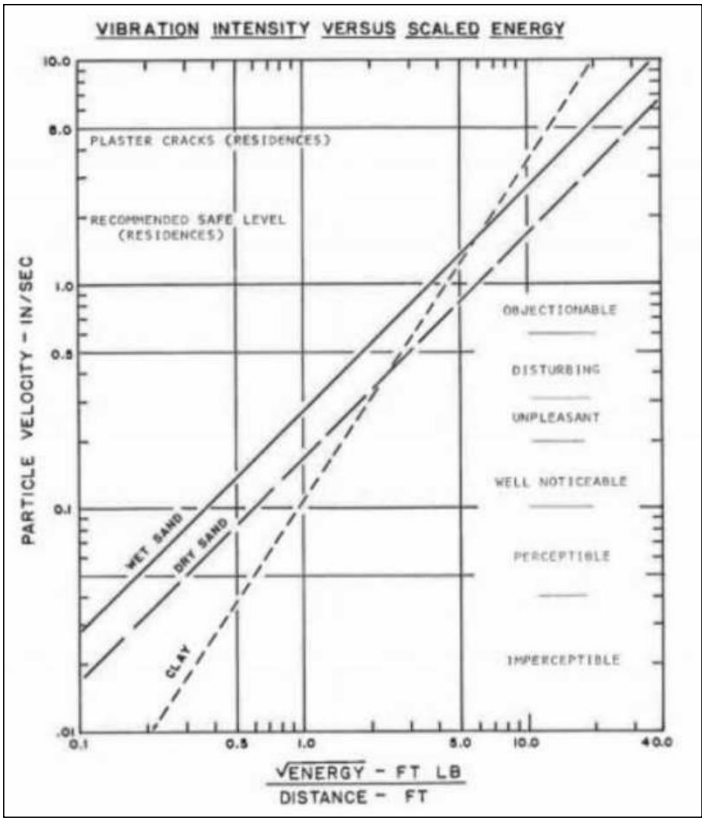


Figure 3.1. Estimating impulse from pile driving on wet sand, dry sand and clay

(Source: John, 1994)

Figure 3.1 shows the expected maximum impulse level when piling on different platforms (wet sand, dry sand and clay). The impulse levels will change around the foot of the pile, the figure above also shows the levels and assessments of experts on vibrations when pilling, in the investigation, the impulse results show no There are many differences in impulse when pilling on different platforms.

According to Bayley et al. (2010), when building a turbine with a height of 100m, a wing length of 50m, pilling operations are estimated to take two hours for each pile, requiring 16 hours for each 2 turbines and need to work in a few days in a row. Noise and vibration from piling also cause great impacts on aquatic animals such as hearing or behavioral disturbances. The study also measured the impact of vibration and noise of pilling in the range of 0.1 - 80km

(the highest measured level is 205dBA), these impacts can affect the Animal aquatic species.

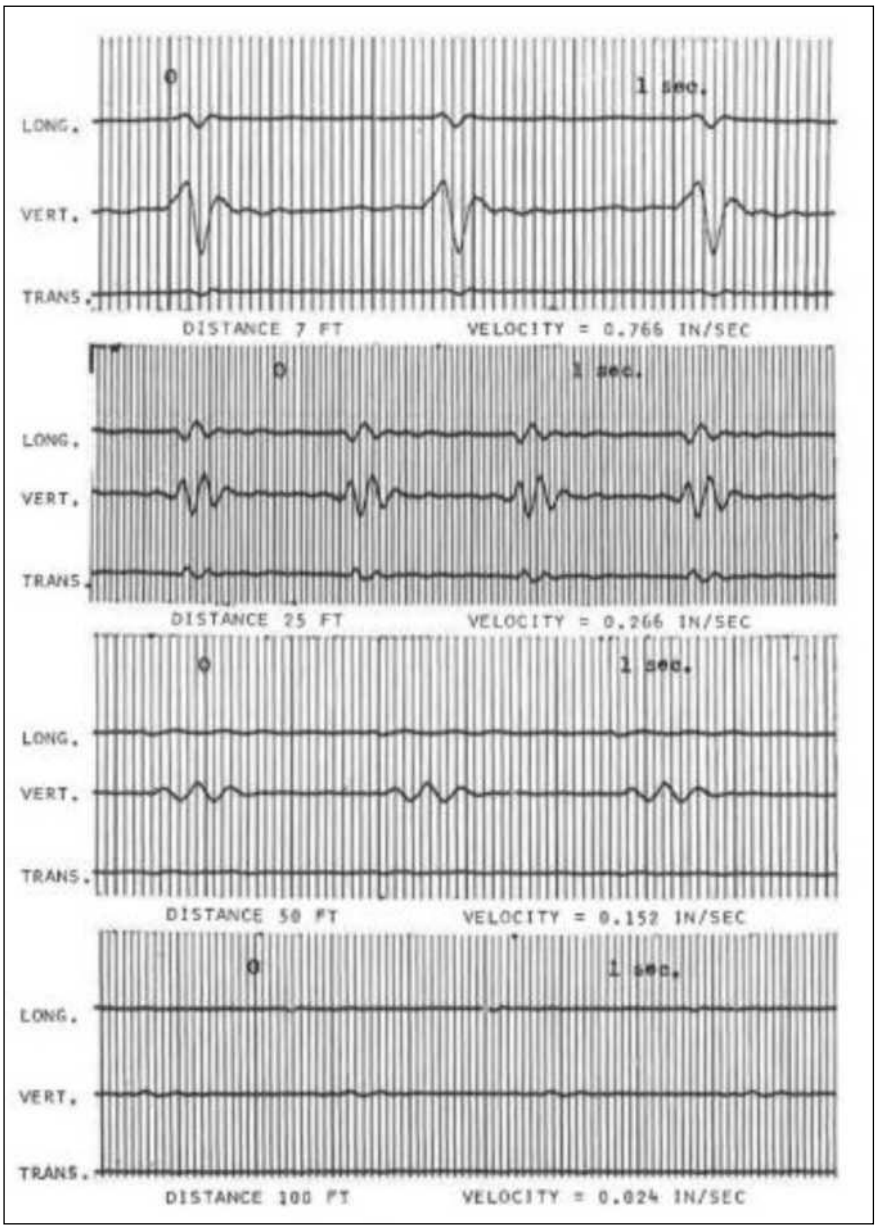


Figure 3.2 The relationship between distance and vibration when driving piles

(Source: John, 1994)

The potential impact from vibration of pile driving depends on the frequency and location of the vibration source. Figure 3.2 shows that with the inverse ratio between distance and vibration as well as the transmission velocity, the farther away the vibration source is, the lower the transmission wave and the speed decreases (the transmission velocity decreases from 0.766 inches per second down). 0.024 inches per second when moving from a distance of 2.13m to 30.48m). The impulse in this country may be the cause for some species of mollusks, crustaceans, fish, crabs, crustaceans forced to relocate.

At the location where the turbine foundation piles are made, the sound from the pilling process and other sound sources is likely to damage or kill aquatic species. The main mechanism of injury is the rapid movement of high frequencies of sound impulses during the driving of piles through the air pockets of multiple aquatic species causing direct damage to the tissue. contact.

3.1.3 Assessment, forecasting the impact in the operation phase

The environmental impacts caused by the project are summarized in the following table:

Table 3.16. Impacts of project in operation phase

No.	Source	Impact	Impacted objects	Impact Level	Position of impact
A	**Impact source and Impacted objects and Level related to waste**				
1	***Wastewater***				
	Daily activities of 10 operational staffs	Domestic wastewater	- Surface water - Ground water	0,96m^3/day	Executive house
2	***Solid waste***				
2.1	Domestic waste of operational staffs	Domestic waste	- Soil environment - Air environment - Natural landscape	2,5-3 kg/day	Executive house
2.2	Production waste	Maintenance of machinery and equipment	- Soil environment - Air environment	20-30 kg/year	Executive house
2.3	Hazardous waste	Fire, explosion, oil of transformer overflowing in accident.	- Soil environment	15-25 kg/year và maximum 30m^3 oil waste	Executive house
B	**Impact source and impacted objects and level unrelated to waste**				
1	Operation of wind turbines	- Birds may hit the turbines spinning	- Categories of birds	Small, controllable;	In the wind turbine location
2	Shadow and flickering effect caused by blades	Visibility of the operating personnel and the people can be affected	The operating personnel and the local people	Low, because the wind turbines' position are	In the wind turbine location

No.	Source	Impact	Impacted objects	Impact Level	Position of impact
				far from the residential area	
3	Weather incidents (wind, lightning, floods, storms, etc.)	- Cable broken - Electrical leakage - Tower fallen - Corona discharge phenomenon	- Maintenance staffs - Local people living around	Small, when the weather incident occurred	At the positions where the weather incident occurred
4	Repairing and maintaining the ROW, turbine	To the trees lying in the ROW, cutting trees and pruning branches if they are taller than the allowable height	Biological Resources, Biodiversity	Small	Along the ROW and the wind turbine location
5	Impact due to noise and vibration	- Noise and vibration generated by transformers and turbines - Transformers and turbines are manufactured having noise <70dBA	- Operating staffs - Local people living around	- Low, because the wind turbines' position are far from the residential area and rotation speed of the wind turbine is 5-7m/s so the noise arisen from the turbines is insignificant.	At the substation and the turbine location

3.1.3.1 Impacted objects related to waste

(1) Impacts on air pollution

During the operation phase, air pollution source mainly is dust emission in place because the wind turbines are built on the ground, there is not enough vegetation to cover the ground surface so sand on the ground is easily emitted to the air environment. In this regard, the project owner will conduct mitigation measures such as planting vegetation around the project area, so the impact is negligible.

(2) Impacts due to dust

1) Domestic wastewater of the operating personnel

Domestic wastewater generated from activities of 10 staffs in the project area is: 10 persons x 120 liters/person/day x 80 % = 0.96 m^3/day (wastewater flow = 80 % of the amount of supplied water).

Domestic wastewater generated daily in the operation phase is 0.96 m^3/day, it contains a lot of suspended solids, high concentrations of organic compounds, residue, nutrients (nitrogen, phosphorus) and micro-organisms. So it needs to be treated to meet the standards before being discharged into the receiving water source.

2) Overflowing rainwater

Similarly during the construction phase, the project operation phase does not expand the categories, the area affected by stormwater runoff is the same. Therefore, it can be seen that the amount of water purchased over the project area during the operation period is 0.156 l / s.
Rainwater runoff through the wind turbine area and substation does not contain toxic substances, is directed to the manholes to collect water along the road of the general drainage system in the project.

(3) Impacts due to solid waste

a) Production waste

During the maintenance process of wind turbines, substation and transmission line, it will arise a specific waste of the maintenance such as segments of electric wire which was broken or burned, rusted insulators, damaged auxiliaries from the operating of turbine, substation, etc. The quantity of this generated waste is about 20-30 kg/year.

The project operating and management unit will collect the entire amount of solid waste generated and will contract with the local environment company for transporting and disposing these solid waste according to the regulations.

b) Domestic waste

Operation of 10 staffs working in the project area will arise a quantity of domestic solid waste from 2.5 – 3kgs/day (estimated average from 0.25 to 0.3kg/person/day x 10 staffs). Main components of domestic solid waste include:

- Compounds originate from organic matters such as vegetables, leftover food, etc.;
- Kinds of packages, food and drink wraps, etc.;
- Inorganic compounds such as plastic, glass, etc.;
- Metal such as food cans, etc.

Domestic solid waste is collected, transported and treated according to the regulations by a competent company, Soc Trang province.

c) Hazardous waste

Hazardous waste generated during the project operation phase includes:

- Wipers stained with grease, batteries, fluorescent lamps, capacitors, etc. are generated approximately 2 kgs/month.
- In addition, during the operation of repair and maintenance of equipment and mechanical means in service of the management and operation of the project, it also generates a specific amount of wastes of maintenance and maintenance. waste oil, broken battery, filter core, ... The quantity of hazardous waste arising from this maintenance is about 2 kg/month.

Insulating oil:

- In the course of operation, the insulating oil is fixed in the MBA and is used to circulate it to cool or function as an insulator. Normally insulating oil does not discharge to the environment.

  Some cases may generate insulating oil out due to transformer failure. Then, the oil spill will be led into the oil collection tank with oil collecting hole and steel pipe ϕ 250, and around the transformer holder, there is a reinforced concrete embankment of 1x2 M200 stone to avoid the phenomenon. Oil spills around.

- The maximum amount of oil spills out when the problem is 30m^3. To comply with the 11 TCN-20-2006 electrical equipment regulations, the oil tank was designed and constructed with a useful capacity of 35 m^3, ensuring that it can contain full of oil waste from substation

  However, the actual reference from the project of wind power plant I in Tuy Phong district, Binh Thuan province has been in operation since 2009 and Phu Lac wind power plant has been in operation in 2016, not yet available. Oil spill caused by malfunction of transformer or sudden generation of hazardous waste. The amount of hazardous waste is mainly generated every month from 2-3kg (ink, fluorescent lights, waste batteries, ...). Therefore, the impact from generated oil is very rare and negligible.

Table 3.17. Generated hazardous waste at substation

No.	Items	Hazardous waste code	Quantity (kg/year)
1	Insulating oil	170303	30 m^3 (only in accident case)
2	Cartridge waste	080204	1-2
3	Fluorescent light	160106	1-2

No.	Items	Hazardous waste code	Quantity (kg/year)
4	Wipers stained with grease	180201	1-2
5	Waste battery	190601	1-2
6	Battery	160112	5-8 (2-3 cans)
7	Capacitor	160114	2-3
	Total		**15-25**

3.1.3.2 Impacted objects unrelated to waste

(1) Impacts due to noise and vibration

When the project comes into operation noise comes mainly from the following two sources:

At the substation area and operator: Noise generated from vehicles to work, travel, etc., each type of vehicle emits different noise levels. However, this impact is negligible due to the low frequency and traffic of vehicles, the vehicles are turned off when coming to work.

At the turbine area: Noise generated from wind turbines:

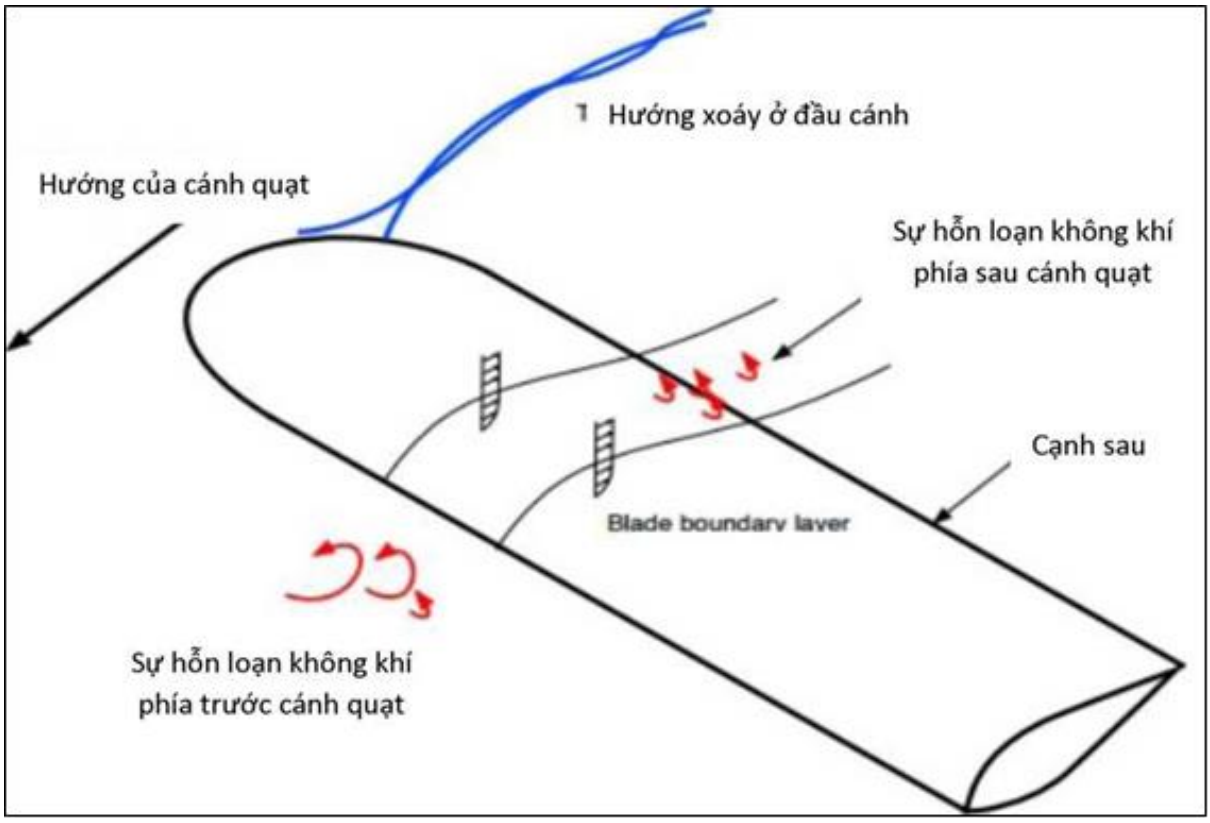


Figure 3.2 Wind flows through the wind turbine blades

(Sources Rudolf Saavedra and Biswanath Samanta, 2015)

Noise is generated from two aspects, the chaos of the air in front and the back of the rotor when spinning. According to Rogers & Manwell (2002) on wind-related noise issues, the noise from turbine blades is divided into categories:

- Negative - noise at discrete number layer: the cause of turbulence in the air when interacting with the propeller
- Broadband: continuous distribution of negative pressure at frequencies above 10Hz. The noise of broadband is due to the interaction of the rotor with the disturbance of the atmosphere
- Low frequency noise: is a noise between 20 - 100Hz.
- Sound wave: noise below 20Hz.
- Impulse: Short sound pulse changes the force over time. Impulse noise is due to the interaction of the impeller with the disturbed air behind the wing.

Evaluate the effect of noise from the propeller

Potential effects of low-frequency noise on health: hearing loss, sleep disturbance and rest, physiological mind, mental health and ability to work (Knopper, 2014).

Sound waves are not the only effect of wind turbines affecting health, learning, sleep or stress, anxiety (Knopper & Ollson, 2014). Sound waves have been shown to cause physiological changes in humans when they reach 110dBA, but there has been no research on exposure to sound waves of turbine blades that cause adverse health effects. or not (Schmidt & Klokker, 2014). Another study said that sound waves near wind turbines do not exceed the sound threshold to affect health (Mccunney et al., 2014).

At the wind power foundation, the rotating wind turbine produces 70dBA mechanical noise. Noise is a major factor affecting human health, affecting labor productivity, hearing organs such as reducing the sensitivity of ears, reduced hearing, causing deafness in the profession. In addition, noise also causes headaches, tinnitus, dizziness, nausea, neurological disorders, cardiovascular disorders and gastrointestinal diseases, joints ... (Saavedraet al., 2015) . Physically sound is vibrating sound waves that appear in the physical environment. Human ears can feel sounds with frequencies between 16 and 20,000 Hz. However, human ears are only really sensitive to sounds with frequencies between 500 and 8000 Hz. The impact of noise depends on the frequency and sound intensity, the repeatability of the noise.

Specific harms of noise in the 1,000 Hz frequency range are shown in the following:

Table 3.18 Noise levels affect people

Noise level, dBA	Affects people
50	Disturbing information exchange, reducing labor performance
70	Influence on heart rate, breathing rate, blood pressure, stomach activity, loss of interest in working.
90	Damage to hearing function, insomnia, neurasthenia

(Sources: Pham Ngoc Dang, Air environment, NXB KHKT, 2003)

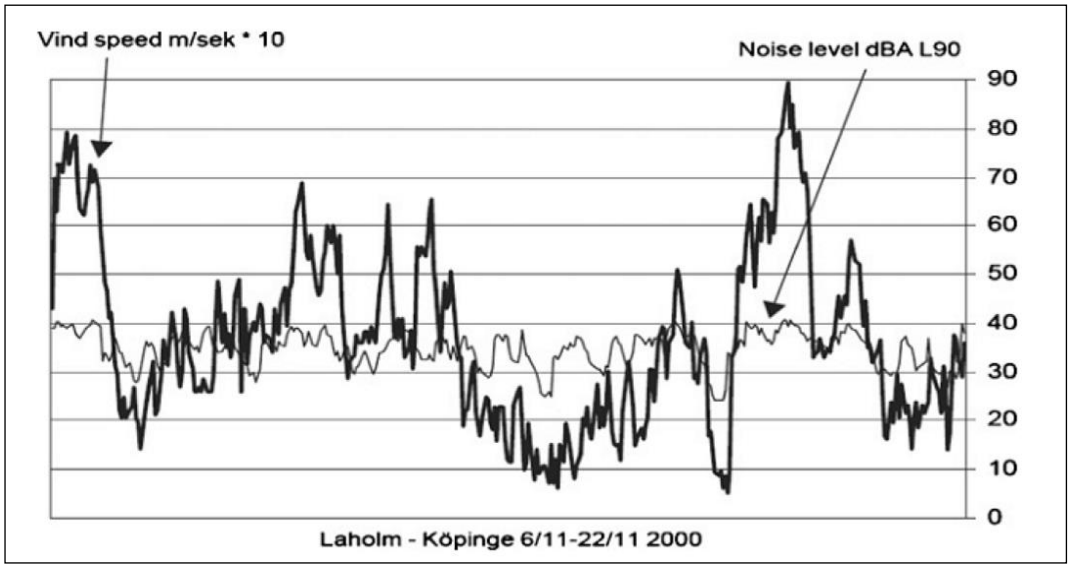


Figure 3.4. Wind speed and noise level at dBA L90 over time

(Sources: Martin, 2004)

Wind direction tends to increase the noise from the turbine to the receiving point. In Martin's study (2004), with the noise level in L90, this study was measured at a location 300m away from the turbine, measuring time in 2 weeks with many different wind speeds from 1 - 9m / s, see The correlation between the sound level and the wind speed at this particular location is relatively low, from here it is possible to see the noise between the wind turbine and the wind speed independent of each other at a distance of 300m.

Noise modeling software

WindPro 3.1.597 noise modeling software is used to calculate noise level by ISO 9613: 2 noise propagation algorithm (international method for general purpose, about 1/1). For sound calculated in ISO 9613: 2, the accuracy is specified as ± 3dBA at source to the reception distance up to 1000 meters (m) and unspecified at distances over 1000 m. Predictor software package allows combining project noise sources with 3D elevation data, background areas and locations of affected objects, thereby creating accurate simulations of wind

farms and pulse areas around. The model allows to quantify the noise level from multiple sources, sound power or pressure levels emitted from each source and calculate the noise spread in the evaluation area for specific quantification. Unit of decibels noise measurement, Leq in dBA is specified at the position of the affected object.

Input data for modeling

Input data for noise models include:

Site layout and specifications of the 7 wind turbines of VETAS and the Project substation as described in Chapter 1. Reference spectrum Vestas V150-4.0 is used for this purpose of evaluation;

Topographic map of the local area;

Meteorological and noise status data (as shown in Chapter 2). Wind speed> 10 m/s, representing noise emissions in the worst scenario when all wind turbines are active and selected;

Location of affected objects around potential noise (see details below).

Modeling results

The results of the software run are presented in the noise simulation map (Figure 3.5) below. As shown on the map, noise level in the project area reaches QCVN 26: 2010 / BTNMT (day time: 70dBA and night time: 55dBA in the normal area) is the noise level at the The most sensitive object is the location of the turbine foundation, with values ranging from 55 to 65 dBA; Noise level decreases with distance, the lowest noise level in HL Road 31 noise level ranges from 35-40 dBA. Therefore, the noise impact on the project turbine areas is expected to be small.

The area is affected by noise

A total of 4 potentially affected subjects were identified with the locations shown in table 3.19 below. Altitude at the affected object to calculate noise at 1.5 and 10 meters above the ground. The subject's height of 1.5 meters is representative of the human being in the sitting position and is often used as a height for assessing environmental noise in general. A 10-meter receptor height is usually applied to wind farms because it is typical height for meteorological metering columns.

Table 3.19 Location of points affected by noise

Code	Location	Describe	Noise (dBA)
R001	Turbine foundation	This area is located on the 7 turbine foundation	55 - 65

R002	Vinh Thuan Company	This area is located in the southern part of the turbine 2, 3, 5, 6	45 - 50
R003	Aquaculture area	This area is located around the turbines.	40 - 45
R004	The nearest households	This area is located on the HL31 road.	35 - 40

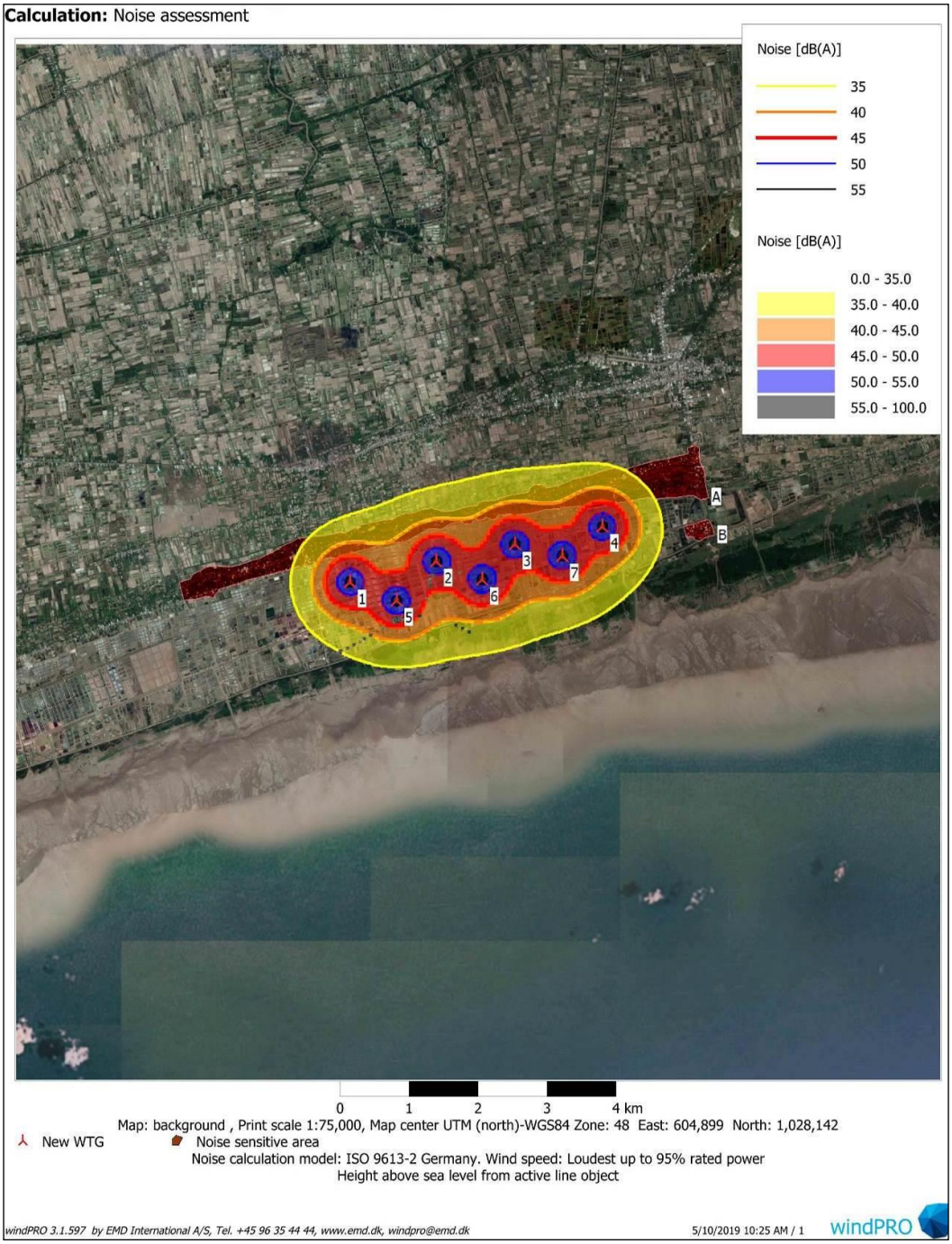


Figure 3.5. Noise levels around the project area

(2) Impact of the flickering shade

The projection ball is made up of two parts: due to the propeller movement and the turbine body, known as the "dance effect", the projection is created by

changing the lighting density, which causes the image to be enjoy people living around the area (Saidur, 2011).

Shading distance: The larger the rotor diameter and the higher the cylinder, the longer the ball will be produced. According to research by Payom et al. (2007) with turbines used at a height of 100m, the propeller radius is 50m (the total height achieved is 150m), the sun angle is calculated to be 60 in the early morning and behind the turbine blades , the motion of the ball can be taken up to 1.094m, assuming the ground is horizontal as shown in Figure 3.6.

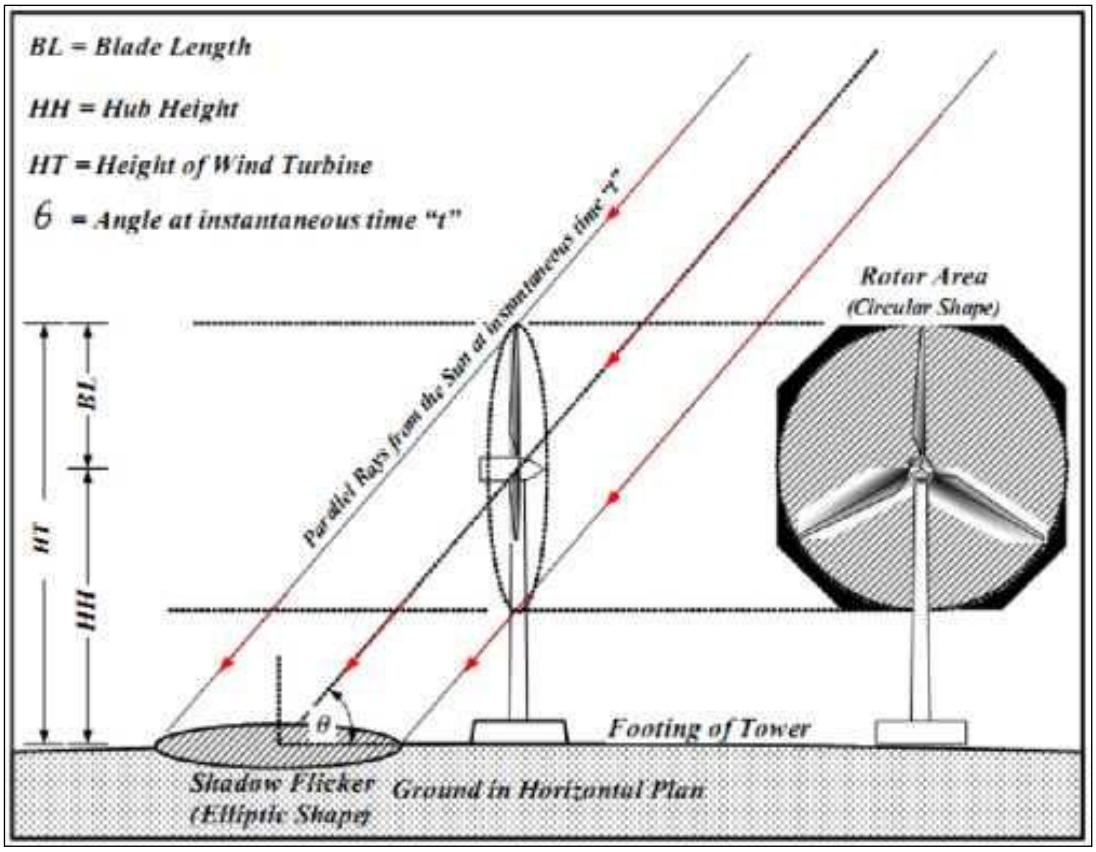


Figure 3.6 The shadow length of the turbine

Shadow time: when the sun rises, the shadow begins to appear, and will gradually decrease as the sun rises, then begins to rise again until the sun goes down. This proves that the flicker on the ground of the ball will increase every morning and afternoon when the length of the ball is the largest. Until noon (Φ ~ 900), the length of the ball is the shortest of the day. The sun moves about 150 per day depending on the time of year and latitude. The shadowing time is the clearest and longest when reaching 45 - 550 at 9:00 to 9:30 (Figure 3.8) (Payom et al., 2007).

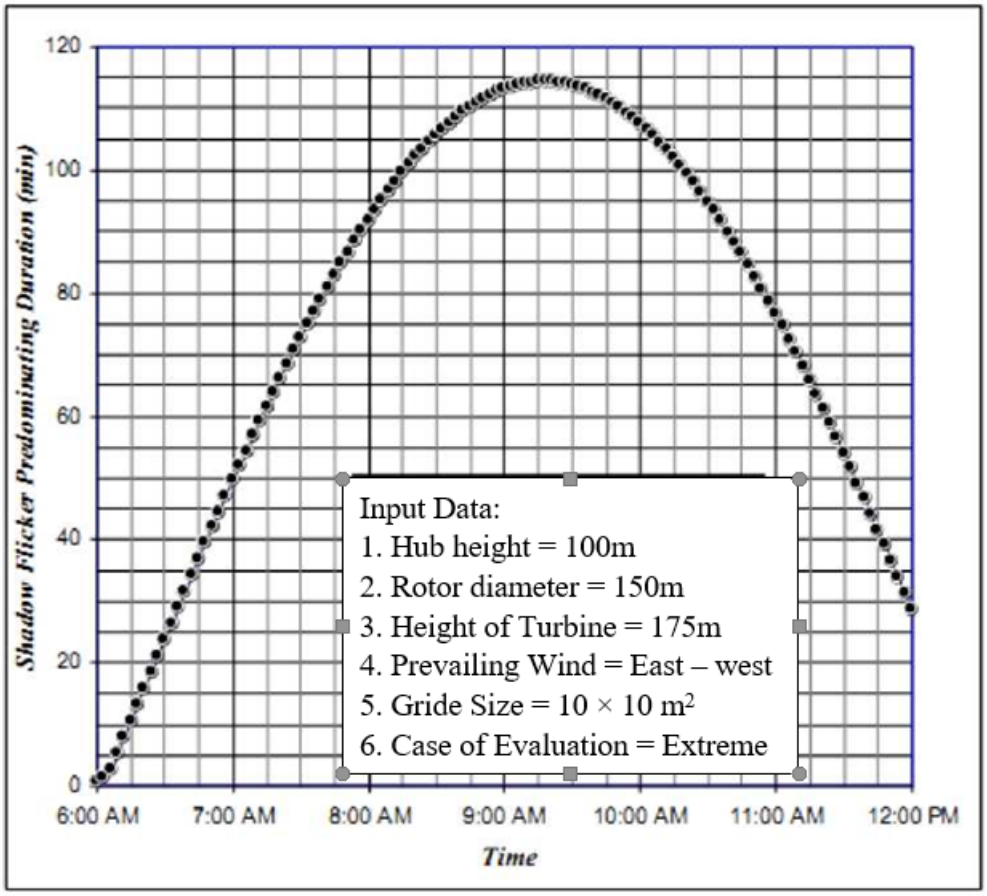


Table 3.20. Long shadow shines hourly in each month

Months	The lonest shadow	Shadow time affects the community	
	Time / day	Morning	Afternoon
1	1,22	06:30 - 07:30	17:00 - 18:00
2	1,01	06:30 - 07:30	17:00 - 18:00
3	0,77	06:15 - 07:15	17:00 - 18:00
4	0,80	06:15 - 07:15	17:15 - 18:15
5	0,96	06:15 - 07:15	17:00 - 18:00
6	1,11	06:15 - 07:15	17:15 - 18:15
7	0,94	06:15 - 07:15	17:00 - 18:00
8	0,83	06:30 - 07:30	17:00 - 18:00
9	0,77	06:30 - 07:30	17:00 - 18:00
10	0,82	06:30 - 07:30	17:00 - 18:00
11	1,33	06:30 - 07:30	17:00 - 18:00
12	1,49	06:30 - 07:30	17:00 - 18:00
Means	**1,003**	-	-

(Sources: Payom et al., 2007)

Evaluation of turbine shadows: analysis of shadows created by SFM wind turbines (Shadow Flicker Model) written by Danish Wind Industry Payom et al., 2007).

The examples of the output of the model are shown in Figure 3.19 and by overlapping the results in all months it will create the annual shadow area, the typical "butterfly" shape is symmetrical because the ground lies horizontal (Figure 3.20) (Payom et al., 2007).

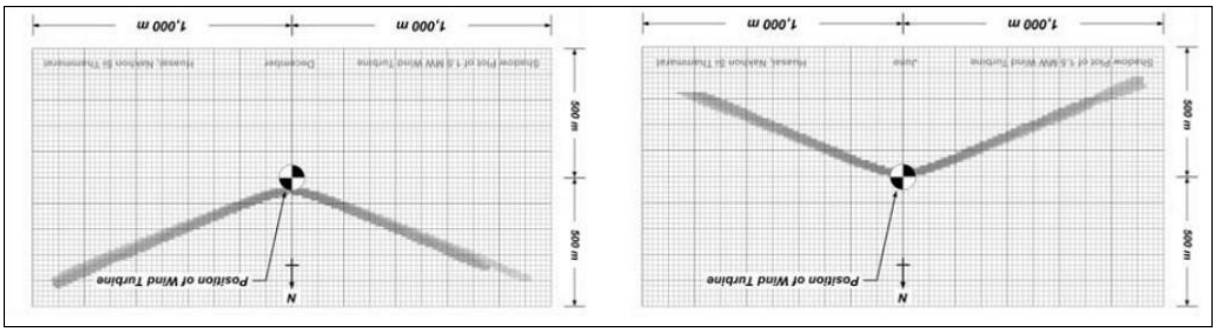


Figure 3.7. Shadow model in June and December

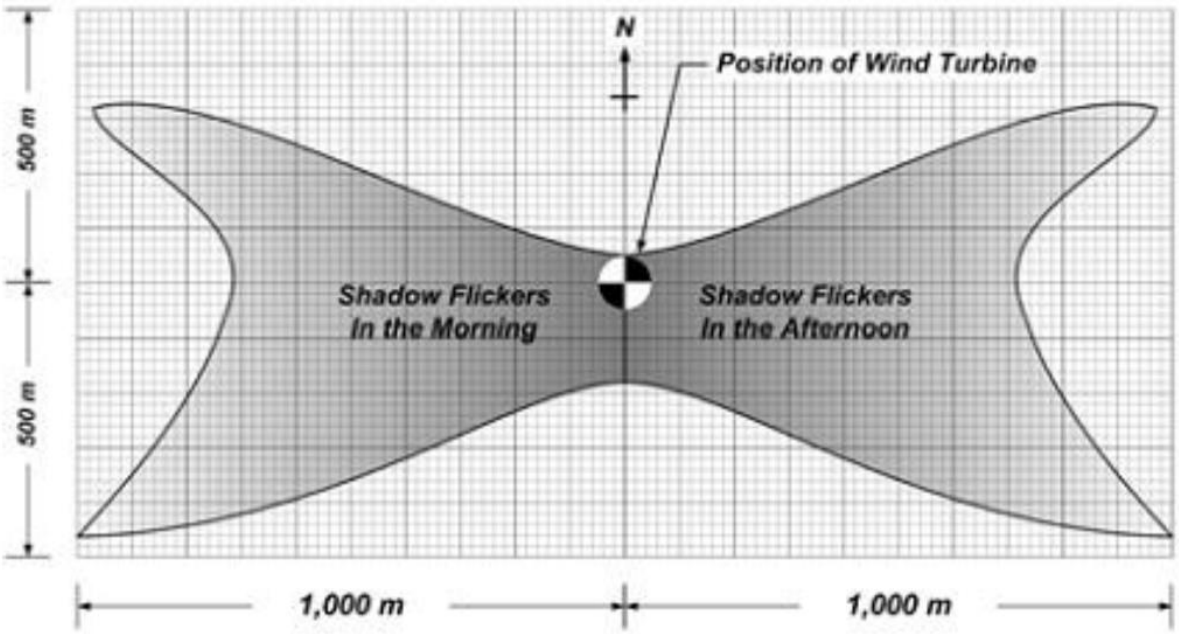


Figure 3.8. Shadow model in the year

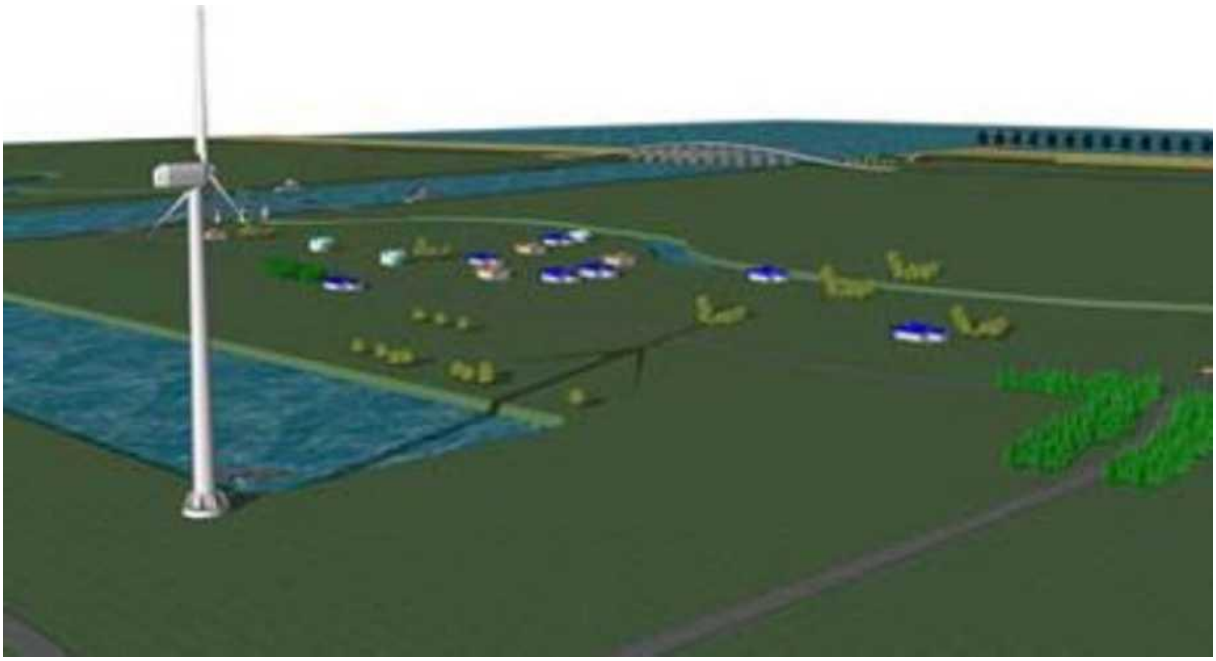


Figure 3.9. Graphic simulation of shading of wind turbines

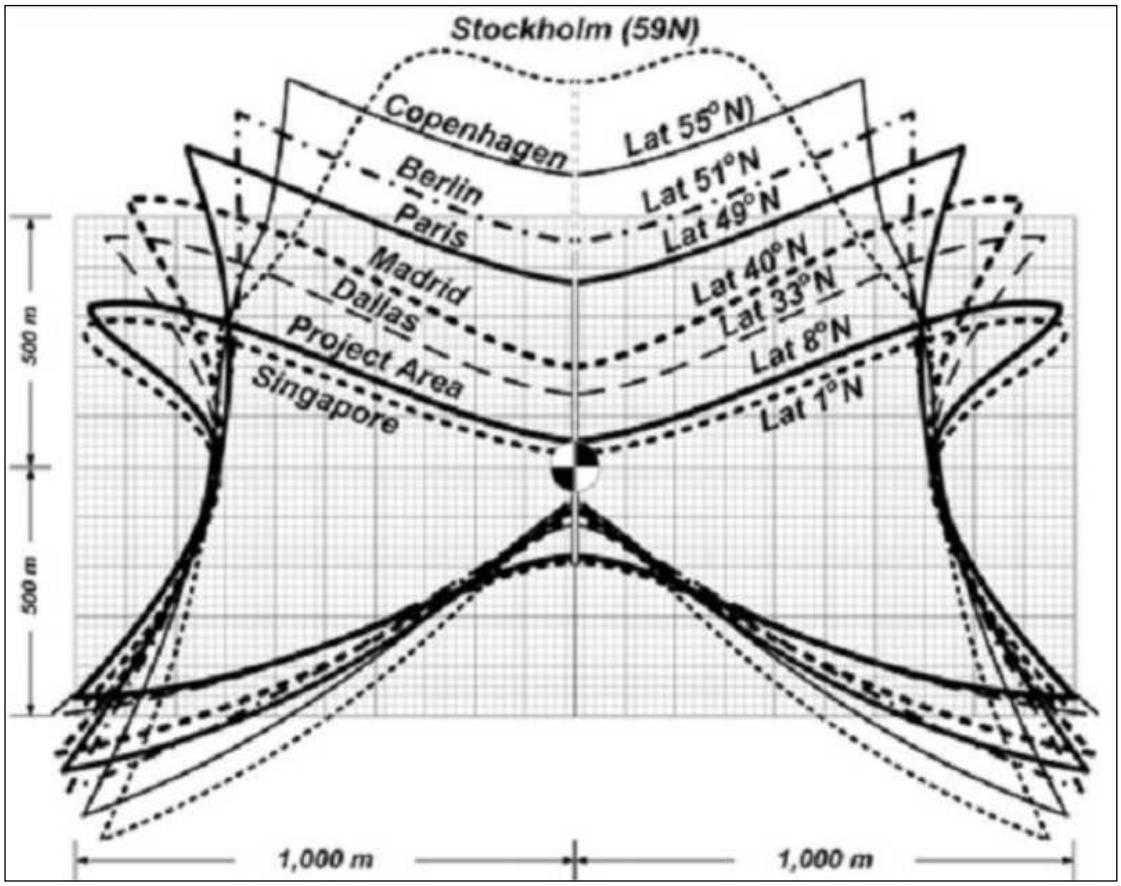


Figure 3.10. Comparison of shadows from wind power projects in some countries around the world

(Sources: Payom et al., 2007)

Wind turbines used in the project have a design with rotational direction to catch the wind, which will create two cases related to the shadow (Figure 3.12)

+ The first case: the road surface rotates the impeller in parallel (forming angle 0^o) with the direction of the sun. In this case, the shadow area will not have a blinking effect, only a vertical shadow column will appear.

+ The second case: the rotational road surface is not parallel to the direction of the sun. In this case, the shadow area will have a flashing effect when the fan moves.

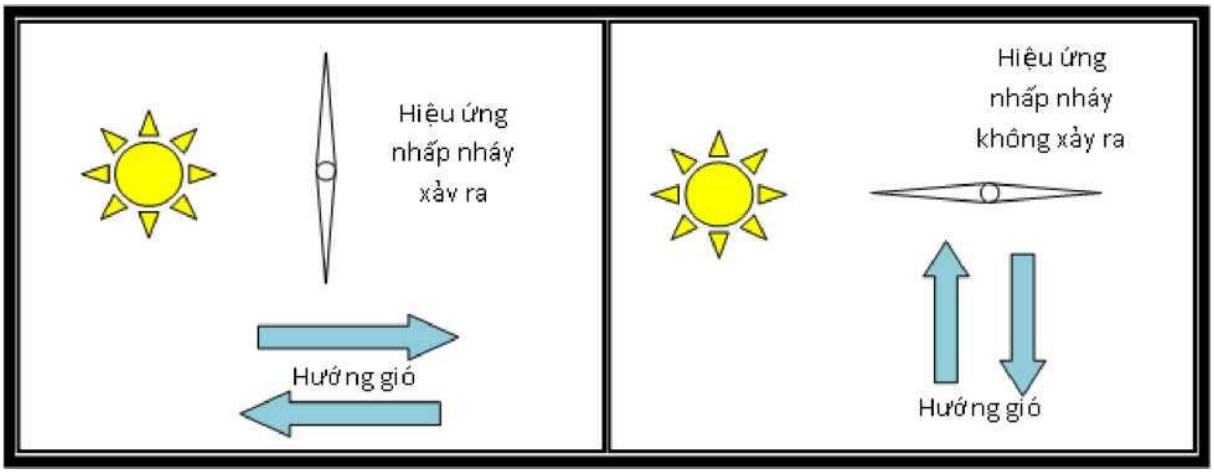


Figure 3.12 The relationship between turbine, sun, wind direction and shadow

The reflection of the light that is projected on the turbine rotor is reflected in the brightness contrast, which can be reduced to a minimum by optimizing the fan surface smoothness as well as covering the turbine with the material. less reflectivity is shown in table 3.18 below:

Table 3.21 Conditions occur the shadow intensity

The intensity of the	**Condition**
The intensity of the shadow bold	- The sun rises or sunset, where the shadow is long enough - The wind turbine plane is perpendicular to the sun - Large wind turbine - Distance from turbine to short residential area
The intensity of the shadow light	- The wind turbine plane is in the same direction as the sun

Balloon modeling software

WindPro 3.1.597 noise modeling software is used to calculate project flickering.

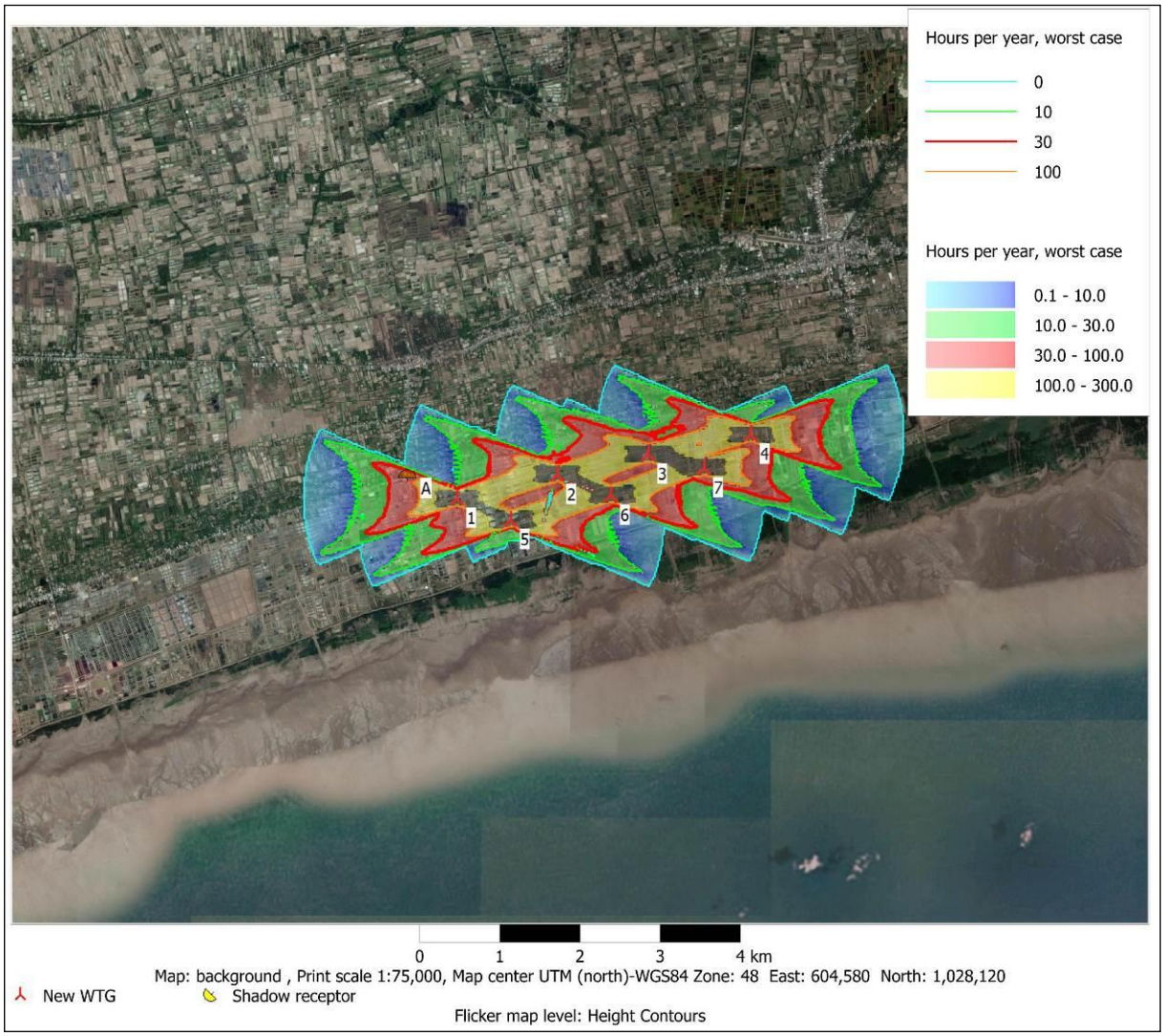


Figure 3.14 Impact map of project flicker

Model results:

Evaluation of the effect of light bulbs from wind turbines: there are a number of effects from the wind turbine shadow to residential communities around the project area. Flashing balls can be annoying when reading books or watching television. However, the effect can be accurately predicted to avoid affecting the surrounding community. In addition, wind turbine pillars are located in the aquaculture area, so the flickering shadow does not directly affect the nearest resident's home.

(3) Impact due to negative sound waves

During the operation of the wind turbines, when the wing rotates the turbine over the air tower compressed and decompressed, the ripples are generated. That ripple causes a series of negatives with frequencies ranging from 1 to 20 times per second, which is below the level of human ears.

This sound wave can affect the health of people living near the wind turbine area with symptoms such as shoulder stiffness, headache, insomnia, tremor, ... In addition, this sound wave also works. to birds and bats if these birds and bats fly near wind turbines

(4) Impact on ecosystems

4.1. In the TBA area and operator

In the construction area, Wind Power Plant No. 3 does not have rare and precious species. Only a few small birds like sparrows and bats. They often live in low altitudes and in shrubs. When the substation and the operator come into operation, it does not affect the ecosystem of this area but the development of domestic wastewater and stormwater runoff can affect the aquatic ecosystem.

4.2. At the turbine area

Magnetism is a form of environmental pollution that can hurt wild animals, which can cause long-term effects on organisms such as reducing natural defenses, reducing health, and reproductive problems and reduce their area of habitat and hunting through habitat degradation (Alfonso Balmori, 2009). In Alfonso Balmori's study (2009) on the effect of magnetic field strength on white storks (Ciconia ciconia) in Spain, the magnetic field strength is above 200m (2.36 ± 0.82 V / m).) higher than those within 300m (0.53 ± 0.82 V / m), those within 100m (intensity> 2 V / m) have many small children with unknown causes, research results The study also showed that magnetic fields also affect the reproduction of white storks.

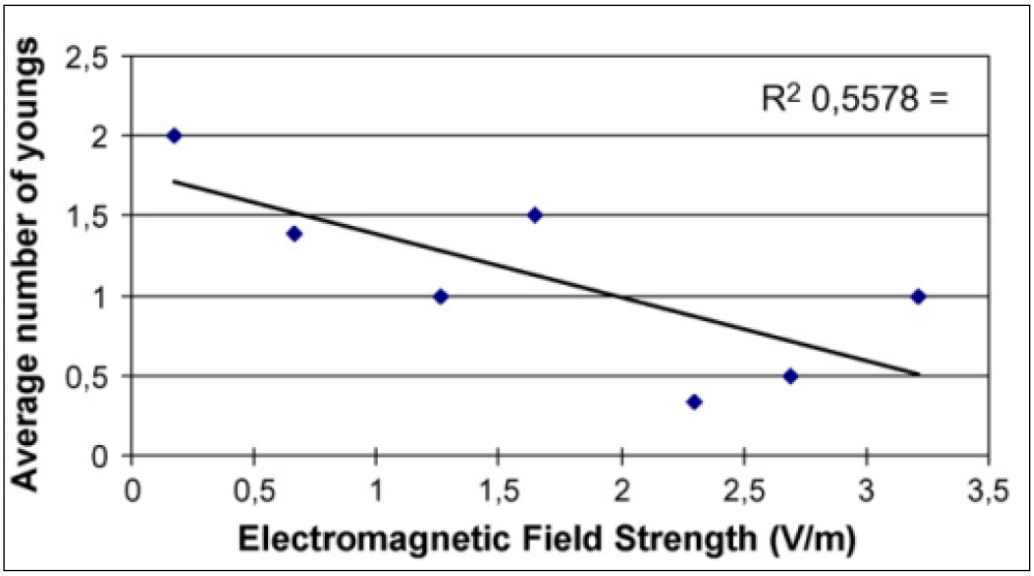


Figure 3.15 The average number of baby storks and magnetic field strength in 60 white storks

(Sources: Hallberg, Ồ with data of Balmori, 2005)

Different animals have different sound sensations, so the level of impact is different and depends on the frequency, intensity and duration of exposure. There are not many species of birds and bats. in the project area. In addition, birds will become accustomed to and adapt quickly to the operation of the fan. Noise can damage the lives of marine creatures, can reduce their ability to feed, find partners and avoid their enemies. Noise also has a negative impact on mollusks, mammals, etc., mollusks such as squid, an octopus and a species of cuttlefish they all show signs of injury. tissue of balancing bags when exposed to sound with intensity from 157 - 175 dBA and wavelength from 50 - 400 Hz for 2 hours.

In theory, when wind turbines go into operation, the noise emitted from the propeller right at the turbine tower can reach 70 dBA. This amount of noise can affect organisms that live around the wind tower.

The relationship between birds and wind turbines is one of the important factors to consider when operating wind turbines (Lucas, 2004).

The implications of the process of increasing wind power development for birds include four main effects: collision, migration to other places, barrier effects and loss of habitat or change. Such effects often cause birds to be directly killed or affect the growth, development and reproduction of birds.

Collision: the risk of collisions depends on a range of factors related to birds such as behavior, quantity, weather conditions, terrain, nature of the wind power plant or even work use of light (Allan, 2006). Large birds (often at risk of collision with parts of wind power (wings, pillars, etc.) (Brown et al., 1992) The risk of collisions also varies with weather conditions, with one Some evidence suggests that many birds collide with wind pillars when visibility is poor due to rain or fog (Karlsson, 1983; Erickson et al., 2001) .The birds tend to fly lower when exposed to high winds. encounter large, thick clouds in the sky, thus increasing the risk of collisions with propellers or wind power poles (Winkelman 1992b, Richardson 2000).

Migration to other places: bird flight to other places may occur during the construction and operation phase of the wind power plant due to the impact of noise, vibration and even the occurrence of Turbine columns alter vision, scale and disturbance levels will vary depending on elements of the ground environment and indigenous species (Allan, 2006).

Barrier effect: the impact of birds changing their flight path or having to fly to other places to avoid wind power poles. This effect causes birds to fly continuously and lose a lot of energy due to the avoidance of a series of turbines, this effect depends on a range of factors such as species, flight patterns of each

bird, flight altitude. , distance between turbines, turbine layout and operating status, time of day, wind speed and wind direction, etc. (Allan, 2006).

The habitat is altered or lost: the loss of a direct habitat arising from the construction of turbine cylinders and other ancillary facilities. Changing the living environment is due to changes in land use. Wind power development can lead to loss of terrestrial and marine habitat (Allan, 2006). Normally, the total area of actual habitat is lost up to 2 - 5% of the total development area (Fox et al., 2006).

The mortality rate of birds is not high due to the presence of wind turbine pillars. Research results show that the appearance and operation of wind turbines has no negative impact on small birds around the wind farm area. However, carnivorous birds feed around wind power plants at lower frequencies before the turbine head (Farfán, 2009).

In a study by Lucas (2004) on the impact of wind power on birds in Tanifa, Spain; The survey was conducted for 14 months, the frequency of searching once a week by expert investigators, when the bird carcass was found to be recorded for age, species, gender, distance to the near turbine. most, type of injury, estimated dead time. The survey results on the number of birds at risk of collisions with turbines only two birds (vultures and eagles) in two different pillars, suggesting a mortality rate of 0.03 children / turbine. / year (Lucas, 2004).

According to research by Sarah and Ellen, birds will have to change their flight paths when flying across turbines. Table shows the percentage of birds flying at different heights and distances between turbines. In the survey with a propeller height of 21m and 16-17.5% of birds flying at this height and the risk of colliding with turbines, 5 - 14.1% of birds flying within 16m from the turbine are at risk. Mechanical collision with propeller.

Table 3.22 Percent of birds fly at different heights

Percent of birds (%)	Height when flying (m)	Percent of birds (%)	Distance between turbines (m)
70 - 75%	<21	74,8 - 80%	>31
16 - 17.5%	21 - 25	5 - 14,1%	<16

(Sources: Saidur, 2011)

Different species of birds have different sound sensations, there are many species of birds that can hear ultrasound that people cannot hear, depending on each species may like or dislike noise at a level Somehow, noise can affect the communication ability of some birds and may affect their number of individuals in the project area.

According to the statistics of the Wind Energy Association (AWEA) and the United States Conservation Agency (ABC) and some countries around the world are developing many wind power plants that show that the percentage of birds or bats is death due to impact on wind turbine blades is very low (only about 1-7.5 heads / 1 wind turbine / 1 year), and the rate of birds, bats ... is much lower than those of activities. Other human movements.

Birds or bats that fly through wind turbines even day or night are aware of and change direction at 100-200m in front of the wind turbine and fly across the highest peak of the rotor wing a safe distance. Some birds will get used to and adapt quickly to wind turbines. Moreover, the wind turbines of Wind Power Plant No. 3 are large in size, the rotational speed of the propeller is low, so birds, bats, ... are less likely to die if they collide with the propeller blades. wind turbines. Therefore, the construction of Wind Power Plant No. 3 will not affect the species here.

4.3. At the line area

The impact of the magnetic field on the regional ecosystem has not been realized during the project's operation period.

(5) Impact on health and comfort

❖ Vision

In addition to the economic advantages of artistic perspective, large turbines can have advantages in the landscape environment because they generally have lower rotational speeds than smaller turbines. Large turbines therefore do not attract visibility as fast rotating objects usually have. Wind turbines of wind power plants No 3 rotors have a low rotation speed from 10.4 to 18.1 rpm and are far from residential areas so it has little effect on human vision.

❖ Change airflow

The location of wind power plant No. 3 is the area adjacent to the sea, the area is much empty, so the effect of turbines on changing wind flow is negligible.Electromagnetic Field

(6) Impact of electromagnetic fields due to the operation of substations

According to scientific statistics, when electromagnetic intensity exceeding the permitted threshold can cause a number of effects on people's health living under the transmission line as follows:

- Impacts cause neurological disorders: Electromagnetic field also adversely affect nervous system. Electromagnetic field impact on the human body is expressed in dysfunction of central nervous system including: increasing fatigue, headaches, poor mood, irritability, etc.

- Impact on the circulatory system*:* Electromagnetic field causes dysfunction of cardiovascular and metabolic systems. The long-term effects of electromagnetic field can cause angina phenomenon. Radiation of electromagnetic energy can cause changes in blood pressure: slow pulse leading to fatigue, headaches, etc.

However, according to the results of electromagnetic measurements of some 110kV stations and below the ROW of 110kV transmission line is very small, below the threshold limit can cause negative impact on human health. Typically, the electromagnetic field test result of 110kV Vinh Chau substation is carried out in December 2019 in the following table:

Table 3.23. Electromagnetic of VSIP 110kV substation

No.	Position	Electric field (V/m)	Magnetic (A/m)
1	Operating room		
	- Inside	296,6	3,6
	- Outside	361,9	4,3
2	Meeting room	284,5	9,5
3	Breaking 110kV field		
	- Output	834,4	18,8
	- Input	1317	25,2
4	Transformer	975,2	42,8
	Article 7 of Decree No. 14/2014/NĐ-CP dated 26/02/2014	5.000	
	Labor sanitation standards QCVN 25:2016/BYT		400

Sources: 110kV Vinh Chau substation, December 2019

Remarks:

- The electric field at the measurement positions in the station ranges from 184,5-1317 V / m, lower than the value specified in Decree 14/2014 / ND-CP on February 26, 2014 (5,000V / m);
- The magnetic field at the measurement positions in the station ranges from 3.6 to 42.8 ° / m, within the hygiene standards allowed with QCVN 25: 2016 / BYT (400 ° / m).

2) Impact the electromagnetic impact of the connection line

a. Standards for electromagnetic fields

Decree 14/2014 / ND-CP dated February 26, 2014 of the Government regulating:

- Clause 2a Article 7: When workers do not use equipment to prevent the impact of electric fields, the working time at the place of electric field is stipulated as follows:

Electric field strength E (kV/m)		< 5	5	8	10	12	15	18	20	2 <E <25	≥ 25
Time to work on a day and night	Minute	Unlimited	480	255	180	130	80	48	30	10	0
	Hour		8	4,25	3	2,17	1,33	0,8	0,5	0,17	0

- Clause 4 Article 13: Houses and works exist under the power grid safety corridor (up to 220kV) must ensure that the electric field intensity is less than 5kV / m at any point outside the house, 1m and smaller from the ground. or 1kV / m at any point inside the house 1m from the ground.

The parameters affect the electric field strength value

- Distance from wire to ground;

- Geometry diagram for arranging wires on the column: phase distance, number of circuits, horizontal and vertical conductor layout, triangle ...;

- Phase sequence layout: 2 phase-matching and reverse-phase layout circuits;

- Wire section, number of wires / phases;

- The number of lightning protection wires on the column, the distance between the conductor and the lightning protection cable.

b. Method and calculation results

The report uses an electric field transition program (EMTP) to calculate the electric field strength under a high voltage line. The electric field strength chart is 1m from the ground surface, as shown in the figure below. Inside:

- Vertical axis: electric field strength E (kV / m);

- Horizontal axis: Horizontal distance (m) of the line. Coordinates X = 0 (m) at the heart of the line;

- The lines represent the safe distance from the wire to the ground (Hat = 8m, 12m).

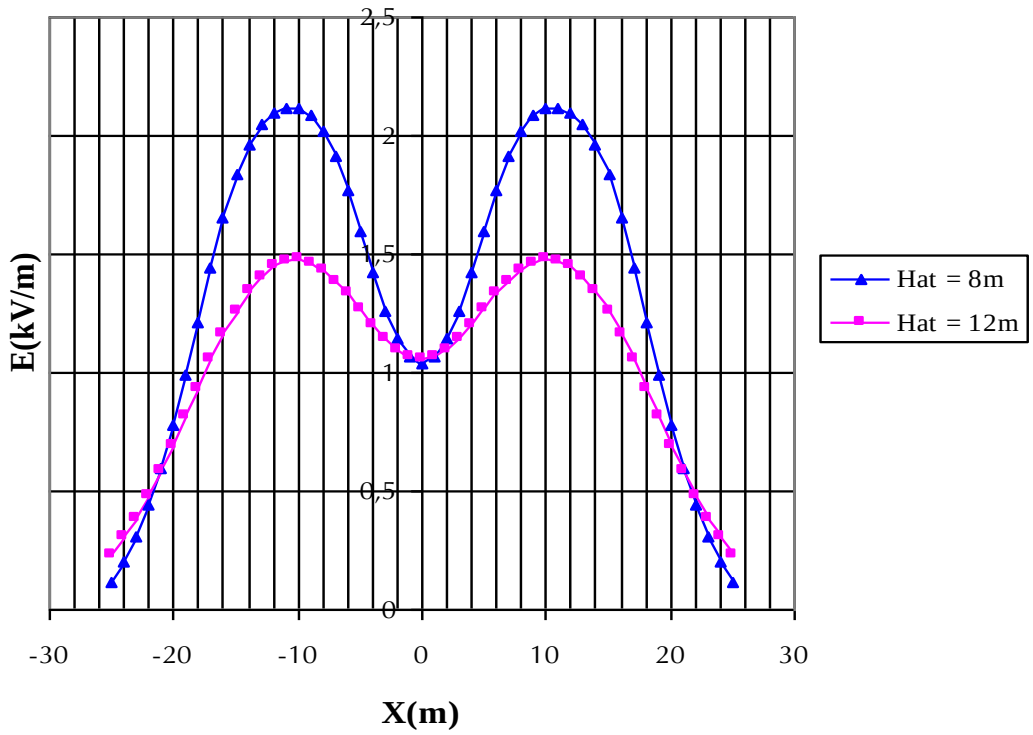


Figure 3.1. Distribution of electric field strength is 1m from the ground of 110kV line

(7) Impact on landscape, architectures

The wind turbine towers are 100m high, 150m diameter blades painted with decorative color which is usually white and pale blue suitable with the environmental landscapes, they will create beautiful and friendly scenery to the environment and can promote the tourism strength in the local.

(8) Impact on air traffic

The height of a wind turbine tower is 100m so according to the current regulations, the project owner will install mast head lights.

(9) Impact on the infrastructure of the local

The wind power plant located in the region is mainly agricultural land having a scattered population density. Therefore, it does not cause adverse impacts to the local people and environment. The project will strengthen the capacity of power supply, improve reliability and reduce power losses for Vinh Phuoc town, Soc Trang province, and accelerate the process of industrialization and modernization. At the same time, the entire area of the plant can be used to plant vegetation for tourism exploitation and building a golf course, etc. The entire environment of the area will be renovated in the sustainable development trend with generating 29.4MW clean power for the country. This will contribute greatly to achieving the goals of economic development of the region. In addition, the project will promote the development of agriculture, urbanization

and services of Soc Trang province, creating good conditions for improving people's lives and reduce the poor household rate. So the economic impacts of the project is positive.

(10) Impact on production activities of people

Positive impact

During the operation of the project, road construction will be carried out, so households can use this road to move for production.

Negative impact

During operation, the impact of noise, flashing, increase traffic density affects the production activities of the people, however, according to the above assessment, these impacts are small and have measures minimize.

(11) Socio-economic impacts

Positive impact

Solving the current energy problem for Soc Trang in particular and for the whole country in general.

Wind energy is considered a "green energy", "clean energy", contributing to saving the use of fossil fuels - non-renewable resources, while reducing emissions of greenhouse gases. global climate change.

Improve the efficiency of land exploitation, solve jobs, provide adequate and stable energy for economic development and improve regional infrastructure.

Utilizing exploitation, tourism development, wind turbines are still new to many people's feelings. Therefore, wind turbines of wind power plants will create a new landscape, contributing to attract many tourists to visit and study and will give the region a new development in the field of economy - sociocultural. In addition, people in the area will have the opportunity to get jobs from the following services when visitors come to visit, increase income and solve part of local labor, contribute to improve Life of the people.

When the project comes into operation, it will contribute to creating a favorable living environment for many aquatic plants, proliferate and grow fast. Increasing the source of seafood is a very important and important resource for coastal communities. This is a favorable condition for the local aquaculture and fishing industry.

Through the survey, the project implementation area is not a fishing ground, so the project does not significantly affect the activities and fishing facilities of the project area fishermen. However, when the project comes into operation attracting a lot of seafood, fishermen can use small boats to be able to exploit in

the project area.

Wind energy is considered to be the most environmentally friendly and has little negative impact on society. Wind is a clean energy source, effectively exploiting the potential of wind power will reduce the burden of dependence on fossil energy is increasingly depleted. Wind energy sources do not pollute the air, soil and water because the electricity generated by wind does not generate waste at all, does not produce acid rain due to SO2, NOx or CO2 greenhouse gases, CH4... does not cause adverse impacts on agriculture, forestry, fishery, construction architecture, ponds, lakes, rivers and streams and human health, etc. Wind power development also contributes to reduce fossil fuel consumption to convert into the amount of electricity corresponding to the energy produced from wind power. According to preliminary calculation, when wind power plant No.3 with total capacity of 29.4 MW is put into operation, it will reduce 0.5764 tons / MWh x 29.4 MWh x 2.881hx 0.3684 = 17,985, 98 tons of CO2 emitted into the environment every year.

On the other hand, implementing the project will help to acquire advanced management skills, modern technology and equipment of the countries supplying equipment for the factory. When the plant goes into operation, it will increase the contribution to the local budget.

Negative impact

When the project gradually stabilizes its activities, in addition to increasing the density of people (visitors) in the area, it will be possible to generate related evils (pickpockets, robberies.) That affect the order society of people in the region.

a. Impact on road traffic activities at crossover

According to the survey results of PECC3, the line has some crossings with roads and rivers, specifically:

- Crossing with soil road: 13 times;

- Crossover with stone road: 3 times;

- Crossover with concrete road: 4 times;

- Cross-intersection with asphalt and national highways: 2 times;

At the intersection with the road, the design process complies with Decree 11/2010 / ND-CP dated February 24, 2010 of the Government regulating the management and protection of road traffic infrastructure. and Decree 100/2013 / ND-CP dated September 3, 2013 of the Government on amending and supplementing a number of articles of Decree No. 11/2010 / ND-CP.

And in the process of designing and building projects, technical elements of the

line such as column position, column foundation, column height, line clearance, ... are considered, designed and built according to regulations. Current regulations are Decree No. 14/2014 / ND-CP ensuring traffic for vehicles and boats.

Therefore, during operation, the line still ensures the clearance of traffic vehicles and boats at crossroads and does not affect waterway and road traffic.

In addition, to ensure traffic safety for vehicles, boats and the safety of the line, the project will install signs at these crossings. The specifications and dimensions of the signal will comply with the current industry standard (TCN 269-2000 and revised, additional industry standards attached to Decision 11/2005 / QD-BGTVT dated 17 January 2005).

3.1.4 *Impact on the environment caused by risks and incidents of the project*

3.1.4.1 During the construction phase

(1) Accident at work

Due to a big quantity of construction so accidents at work easily occur, so the problem of labor accident is considered from the beginning and safety measures must be strictly done during the construction phase. The highest risk of labor accidents often occur in the construction phase related to the installation of equipment on high positions, oversized or overweight equipment.

Labour accidents can occur for construction workers in the construction area near transmission lines, large load machines, cranes and foundation holes. When construction works are well managed, safety regulations are strictly obeyed, workers are equipped with adequate labor protection means with high quality, these impacts can be minimized.

At the same time, the experience of the professional building contractors, along with strict adherence to safety regulations during construction as well as closely monitoring and timely rescue can minimize loss of life and property.

(2) Fire hazard, explosion

Environmental incidents in the construction phase are also implicit in the fuel depots. Ability of leakage and explosion can happen when there is a problem associated with the construction activities such as soldering or short circuit, which is a common cause of fire in the construction sites. So safety measures for the storehouses need to be strictly implemented and tightly controlled.

The construction methods do not use explosives but only use manual labors cooperating with motorized means. So, fire safety is guaranteed. However, the fire possibility due to use of a stove or butts of construction workers is a

potential risk for fire safety issues during the construction phase in the dry season.

(3) Traffic accident

Traffic accident can occur at any time during construction, causing damage to property and life. The cause may be due to transport means are not ensure techniques or workers are not attend or not observe principles of traffic safety. This problem is completely avoided by checking the technical condition of the transport means to ensure traffic safety, propaganda to improve the sense of excuse traffic rules foe workers.

Overall, during the construction phase, the project will not cause significant negative impact on the natural environmental quality. The project will not use or discharge any toxic substances into the environment. Significant impacts due to the project are land acquisition, however, with the characteristics of wind power, its impacts on the socio-economic environment and ecosystems is positive and living conditions of the affected people are maintained or improved compared with before implementation of the project.

(4) The risk of being affected by residual bombs after the war

The construction of the line in areas with bombs left behind in the war can lead to serious consequences, endangering human lives and property of workers and residents. methods, adversely affecting the environmental quality of the region.

According to EVN's regulations, the investor has sent a written request to the Military Command of the project area along with the route map to consider the possibility of remaining bombs in some areas. Project investors will coordinate with specialized agencies to implement measures to zone and clear bombs. This work must be carried out before construction.

In general, during the construction phase, the project does not cause any significant negative impacts on the quality of the natural environment. The project also does not use and dispose of any hazardous substances into the environment. Due to the characteristics of the 220kV line, the impact on the socio-economic environment of project construction is significant through land appropriation and relocation activities. However, in the pre-construction phase, the resettlement compensation program has been studied and implemented in accordance with Vietnamese regulations to ensure the maintenance or improvement of people's living conditions. affected people compared to before project implementation ..

3.1.4.2 During the operation phase

(1) Insulating oil leakage in transformers:

During the operation phase, fire risk at the substation could happen and all of the fire ability could be related to the technical operation of station. Oil leakage during fire could adversely impact on the environmental quality. However, a tank is designed for collecting oil leaked or spilling from the transformers so the ability to affect the environmental quality is low.

An emergency oil collecting tank is designed with a bottom and walls made of cast-in-place reinforced concrete (grade 200) and a precast reinforced concrete cap. The tank has a capacity of 35m^3 (length x width x depth = 4m x 2.5m x 2.5m), it will be built at the transformer area with capacity of 40MVA of the 110-kV substation of the Wind Power Plant No 3 and will get many compartments for separating oil and water.

Under the provisions of the Electricity of Vietnam, the insulating oil used in transformers does not contain polychlobiphenyl (PCBs).

(2) Risk of electric shock, fire and explosion:

The main cause of fire is mainly due to the negligence of the operational staffs who let the components such as paper, plastic catch fire or fuel leaked in the project area.

In addition, the causes of fire and explosion in the project area may also be due to electrical malfunctions or lightning. The risk of fire in the project area is potentially huge so the project owner must have a proactive plan to prevent this incident.

The cause of fire incidents:

- Transportation of flammable liquids such as gasoline or oil going through or near the thermal source or sparks.
- Employee's carelessness when throwing butts on the oil or combustible fuel storage;
- Incidents such as electrical leakage, exploded fuses, etc.

If a fire occurs, it will cause huge damage to people, property and the environment. Therefore, the project owner must implement safety measures including prevention and fighting fire and electrical safety.

(3) Landslide Risk:

According to the survey, flooding and landslides has not happened in the construction area yet. In addition, the tower foundations were dug to the guarantee depth and the regional geological condition was considered carefully in design, so impacts due to floods and landslides are very low.

(4) Subsidence of structures, fallen towers:

Subsidence of structures can occur due to the following causes:

- Corrosion of the wind turbine foundations and transformer;

- Subsidence of the structures.

The process of geological survey is fully implemented and complied with the technical requirements before project construction, it shows that geological condition of the project area is pretty good, load bearing capacity of soil is relatively good.

At the same time, the process of construction and design must be done in compliance with regulations and technical procedures. According to the survey results, subsidence of the structures have not happened in the construction area yet. Therefore, the possibility of building subsidence incidents is low.

(5) Accident at work:

During the operation phase, accidents at work may occur including:

- Accidents while operating or controlling equipment of the project;
- Electrical shocks, etc.
- Accidents while repairing or maintaining the structures.
- The issues of safety and health of the operating personnel are considered carefully so accident at works will not happen if the operational staffs strictly comply with the safety regulations when operating the project.

(6) Risk of Natural disaster:

During the operation phase, risk of natural disasters such as heavy rains, storms, etc. can cause loss of electrical safety for the project operation. Therefore, the weather issues must be considered carefully and the project owner must have some measures for preventing and minimizing to ensure electrical supply safe and continuous for the local people.

3.1.5 General assessment

- For an overview of the environmental impacts as well as the level of impact of the whole project, the overall environmental impact assessment of the project is made based on the method of listing, scoring and expressed in matrix form.
- The vertical axis of the matrix lists the activities of the project and the horizontal axis lists the environmental aspects affected by the project. Impact levels are expressed in cross-sections between environmental and project aspects. The impact level is described in four levels, from no impact to high impact, corresponding to scores from 0 to 3. The impact level of each activity on each environmental aspect is determined based on the results obtained.

The environmental impact price is shown above. The aggregate impact from each activity of the project is the mean level of impact of the activity on each of the environmental aspects. The results of the environmental impact assessment are shown in the table below:

- Summarize the environmental and socio-economic impacts of the project.

Table 3.24. Summarize the environmental and socio-economic project' impacts

No.	Work items	Environmental aspects, impact levels						
		Air	Water	Soil	Ecosystem	Health	Socio-Eco	Average
I	**Pre-construction**							
1.1	Project location	0	0	0	0	0	1	0,17
1.2	Land acquisition, clearance	0	0	0	1	0	2	0,5
II	**Construction phase**							
2.1	Flat levelling	2	0	1	0	1	0	0,67
2.2	Excavation and embankment	3	2	2	1	2	2	2,00
2.3	Constructing items	2	2	1	1	2	1	1,50
2.4	Transportation of materials, equipment for the project	2	0	1	1	1	2	1,17
2.5	Activities to reserve, preserve fuel and materials for the works	1	1	2	0	1	1	1,00
2.6	Daily activities of staff	0	1	1	0	0	1	0,5
III	**Operation phase**							
2.1	Operation, repair, maintenance	0	1	1	0	1	0	0,50
2.2	The operation of the substation and the connection generate electromagnetic fields	0	0	0	0	1	1	0,33

No.	Work items	Environmental aspects, impact levels						
		Air	Water	Soil	Ecosystem	Health	Socio-Eco	Average
2.3	Daily activities of staff	0	1	1	0	0	0	0,33
2.4	Transformer problem	1	1	1	1	3	2	1,50

Note:

0: No impact

1: Low impact

2: Medium impact

3: High impact

The table above shows that the project activities at the preparation stage and operation stage have low impact for environment and social – economic and activities at the construction stage have impact from low to medium. These impacts may be limits by measures to control pollution and reduce the environmental impacts presented in chapter 4 of this report.

3.2 Comments on reliability of assessment method

3.2.1 Environmental impact assessment methods are used in this report including:

3.2.1.1 EIA method

- List method and matrix method:

List table and matrix are used to establish relationships between project activities and environmental impacts.

- Comparative method:

Based on survey result, measurements at the site, analysis result in the laboratory and theoretical calculations result compare with Vietnamese standards to determine environmental quality at the project area, Refer to the document about scale of similar projects;

These methods have been researched and published in a number of specialized documents, which are highly accurate, provide quite enough necessary information to carry out the assessment, forecast environmental impacts, create the quite solid basis to build environmental supervision program during construction and operation stage of project.

- Forecast method and specialist method

Some impacts should be anticipated based on similar projects, practical test

and calculation tools are consulted by specialists. From the forecasting result, impacts will be classified and proposed appropriate mitigation method;

This method based on argument and experience to guess, forecast possible impacts. On that basis, consider impact of the project for environment quality;

This method is subjective, results depend on awareness and level of research specialist.

- Fast assessment method

This method was issued by the World Health Organization (WHO) 1993. The basis of the fast assessment method is based on nature of the material, the technology, the rules of the processes in nature and the experience to determine pollution parameters;

This method gives limited results in the case of parameters and data on the industry, limited activity. In this report there are many data on the amount of waste (waste gas, waste…) during the construction period (excavation, transport…) is estimated based on the scope of influence, climatic conditions, assumptions. In practice, the actual conditions of the climate are very changes, so it can be seen that quantitative data on pollutant load is difficult to reach 100%

3.2.1.2 Other methods

- Field survey, field sampling and laboratory analysis

Determine parameters of air quality, water quality, noise level in project land and surrounding area.

- Statistic method and data processing

Implementing field investigation at communes where the project will be built. Collecting data by questions in field investigation, direct interviews, etc.; Working with relevant responsible agencies in environmental management for the project such as Department of Natural Resources & Environment, and Natural Resources & Environment office at districts where the project will be implemented.

After collecting, these data will be evaluated by many methods such as descriptive statistics, deductive statistics, evaluation and test, etc. and processed to analyze data to investigate environmental factors (such as land, water, air...) for the analysis of environmental status and EIA;

The method was verified and standardized. Results can take random error.

- Modelling method

The assessment in the EIA report is quite accurate because it was based on the

solid basis, the specialized technical documentations of the professional units in the country and abroad.

The assessment methods and mitigation measures are selected and based on the actual operation of the similar plants so it has feasibility and achieves high efficiency.

Evaluate the reliability of the method used:

- The assessments in the EIA report are fairly accurate due to the solid basis, the specialized literature disseminated by specialized units in nation and abroad
- Selected impact assessment and mitigation measures based on actual operation of similar lines are therefore feasible and highly effective.

Table 3.25. Reliability of the EIA methods

No.	EIA method	Level of reliability
1	Statistic and data processing method	High
2	Comparison method	High
3	Forecast and expert method	High
4	Rapid assessment method	Medium
5	Field survey, field sampling and laboratory analysis	High
6	Modeling methods	Medium

3.2.2 Comment on level of reliability

Environmental impact assessment tools are the methods presented and evaluated above. Evaluation results are reliable, so the impact assessment and impact of the project on the environment for each stage is realistic.

Table 3.26. Comment on the level of detail and reliability of reviews

Impact	Activities cause pollution	Comments on the assessments
PRE-CONSTRUCTION PHASE		
Local people	Land acquisition	Number of impacts in the report is generally calculated for design and estimation of compensation expenses for the project. Therefore, the number in the report is not 100% accurate, it will be correct after the demarcation. In addition, there will be certain problems at the time of clearance
CONSTRUCTION PHASE		
Dust/exhaust gas	Operation of transporting machinery and material and other construction activities	The formulas used are the empirical formulas which have high reliability and are used widely. Calculations are based on the quantity of materials, schedule and number of construction machinery.

Impact	Activities cause pollution	Comments on the assessments
		Defects: actual pollutant load dependent on the operational regime of machinery, equipment, vehicles such as fast initialization, slowing down or stop. Actual transporting volume of raw materials are not even and correct as expected. Calculation of dispersal range of air pollutants depends on meteorological factors at each time point. The values of parameters obtained are only annual average values. Therefore, the errors between the calculated values and the practical measured values are inevitable.
Wastewater	Activities of construction workers	*Discharge and concentration of contaminants in domestic wastewater*: domestic wastewater is based on the personal using demand and the average pollution quantity referred from *Wastewater Engineering. Treatment, Disposal, Reuse*. Therefore, there will be error in the calculated results because the water use demand of each individual in daily life is very different. Impact scope: to calculate the influence scope due to the pollutants it is necessary to identify many parameters from many different water receiving sources. Due to this lack of information so the determination of influence scope is relatively meaning.
Solid waste	Activities of construction workers	Calculation is based on the number of workers, actual data which the project owner planned for the project construction. The quantity of solid waste generated is estimated based on the standard for average emission so when compared with the actual data there will be inevitable error.
Hazardous waste	Construction activities	Calculating base on the quantities of machine, equipment in construction phase Generated hazardous waste is estimated on average as opposed to reality, so that might some mistakes
Noise	Construction activities of machinery and equipment	The formulas used are the empirical formulas which have high reliability and are used widely. Noise calculations are based on the survey of noise during the construction process of Prof. Dr. Nguyen Dinh Tuan and associate. Defects: noise level depends very much on the noise level of each vehicle, traffic discharge, vehicle components and characteristics of the road and surrounding terrain, etc. The noise level of vehicle flow is often unstable (it changes rapidly over time), so some noise values equivalent to average integral over a period of time are used to characterize for the noise level of the vehicle flow and which is measured by the equipment measuring average integral noise.
Other impact	Traffic in the area. Biological Resources Social Economy.	Analysis and evaluation is fairly detailed based on the specific detailed field survey. The opinions of the local community allow adjustment of comments to be more realistic.

Impact	Activities cause pollution	Comments on the assessments
	Order and security at the local area.	This analysis was based on the experiences of the similar projects in other locations and the statistical data of many reliable sources. Evaluation result is reliable.
OPERATION PHASE		
Domestic wastewater	Receiving sources	Regarding wastewater flow in terms of water supply, or based on the experience of calculation can be the error compared with the reality. Impact scope: To calculate the extent of the impact of pollutants, it is necessary to clearly define the parameters of the source. Relative evaluation results are reliable
Domestic waste	Daily activities of staff	The calculation is based on the number of staff expected by the project owner. The amount of solid waste generated is estimated by the average emission norm, so it is inevitable that the amount of waste generated will be inevitable.
Hazardous waste	Substation operation	The calculation is base on experience and refer the other similar projects. Assessment of this method is reliable.
Socio-economy	Local socio-economy development	Analyzing and evaluating in detail based on actual construction. Assessment of this method is reliable.

CHAPTER 4 MEASURES FOR PREVENTING AND MITIGATING ADVERSE IMPACTS, ENVIRONMENTAL INCIDENT RESPONSE

Correspondence with environmental impacts are defined in chapter 3, mitigation measures for adverse impacts will be carried out as follows.

4.1 Measures for preventing and mitigating adverse impacts due to the project

4.1.1 In the pre-construction Phase

4.1.1.1 Mitigation measures related to waste

In the pre-construction phase, the project almost does not generate emissions, wastewater and hazardous waste.

Minimizing the impact due to solid waste generation

- Minimization of cutting down trees unnecessarily (trees are outside the tower foundation building area and the trees do not violate the safety height of the power grid).
- Use manual methods for vegetation clearance, avoid using machinery and herbicide.
- For trees which were cut down for the project construction and protection of the ROW, they will be collected for using as wood or firewood.

4.1.1.2 Mitigation measures unrelated to waste

(1) Selection of project location

- To minimize the impact to the least, the design consultant company of the project (PECC3) surveyed, designed and proposed the location of station construction with criteria to avoid the maximum residential area, public place are often crowded with people, important works related to security, national defense, historical-cultural relics.
- Therefore, the location of the selected project is the most suitable, minimizing impacts on local socio-economic conditions as well as socio-economic conditions. Location of the project does not relocated the house or any architectural of any households. Moreover, the project will contribute to improving the stable supply of electricity for production and social-economic development in localities and area.

(2) Minimize negative impacts on households affected by land clearance

- Part of the land area for project implementation shall be cleared by the State and assigned to project owners according to regulations.
- As mentioned in Chapter 3, the time of construction of the project will be selected after harvest is harvested. In cases where the harvest is not yet

harvested, the site clearance must be carried out by the project owner and the contractor will count and compensate all damages to the affected households.

- The project owner will combine with the local Compensation Council to execute the compensation and support polices for the project affected households. Unit price of compensation and assistance will be submitted by the Compensation Committee to the People's Committee of Soc Trang province for approval;
- Project owner and local Compensation Council will carry out the following works:

  + Measurement of land plot;
  + Statistics;
  + Submitting compensation and support plan to PPC for approval;
  + Payment for affected.

Compensation and support policies:

✓ Compensation and support for land

- Land recovered for project construction will be compensated. The actual compensation unit price will be submitted by the Resettlement Committee to the provincial People's Committee and approved and complied with Decision No. 34/2014 / QD-UBND dated December 31, 2014 of Soc Trang Province People's Committee on issuance. prescribe a number of policies on compensation, support and resettlement when the State acquires land in Soc Trang province and Decision No. 09/2017 / QD-UBND dated February 22, 2017 of Soc Trang Provincial People's Committee v/v promulgating regulations on density, norms, compensation rates, support for aquatic plants, crops and livestock in Soc Trang province.

- For residential land located in the power grid safety corridor:

Article 13 of Decree No. 14/2014 / ND-CP dated February 26, 2014 of the Government stipulating that houses and construction works exist in electric safety protection corridors of voltage up to 220kV if they meet Safety conditions, therefore, are not relocated and will be supported by limited usability.

According to Item 3b - Clause 1 - Article 19 of Decree 14/2014 / ND-CP of the Government, the support is implemented once, the specific level of support is stipulated by the provincial People's Committee but the compensation and support level is not greater than 80% of the compensation for land acquisition on the land area within the corridor.

- For other types of land on the same parcel with residential land located in the safety corridor:

According to Section 3c - Clause 1 - Article 19 of Decree 14/2014 / ND-CP of the Government dated February 26, 2014, on the same parcel of land, including residential land and other land types of a land user, When the power grid safety corridor occupies a space larger than the residential land limit, the area of other types of land on the same parcel of land in the corridor shall also be compensated and supported due to the limitation of usability. The compensation and support level shall not exceed 80% of the compensation level for recovering other land categories calculated on the area of other land categories lying in the corridor.

- For perennial tree land located in the power grid safety corridor:

According to Clause 2 - Article 19 of Decree No. 14/2014 / ND-CP of the Government dated February 26, 2014, land for perennial crops in the corridor of safety protection of overhead power transmission lines is supported by the owner. due to limited use of land. The support is carried out once, not more than 30% of the compensation for recovery of perennial crop land calculated on the area of the safety corridor.

✓ Compensation and support for households/structure

- Housing / works are restricted in use and influence in living because they are under the 110kV grid safety corridor: Article 13 Decree 14/2014 / ND-CP dated February 26, 2014 of the Government prescribing that houses and auxiliary works for daily life must not be relocated from the safety corridor of the line of up to 220kV if safety conditions are met. Owners of houses, auxiliary works for daily life shall be compensated and supported due to limited use and influence in daily life. Support is done once. The specific level of support shall be stipulated by the provincial People's Committee, but not more than 70% of the value of houses and auxiliary works for activities on the area within the safety corridor.

✓ Compensation for crops

- All trees and crops available prior to notification of project implementation, if removed for construction of the project, will be compensated. The actual compensation price will be submitted by the Resettlement Committee to the provincial People's Committee and approved.

✓ Support and stabilize life

Total estimated budget for compensation and support activities of the project is **10.818.500.000 VND.**

Support stable life and stable production

According to Article 19 of Decree 47/2014 / ND-CP dated May 15, 2014, households directly engaged in agricultural production when agricultural land is recovered will be supported:

- Withdrawal from 30% to 70% of agricultural land currently in use is supported for life stabilization for a period of 6 months if it is not required to relocate and within 12 months if having to relocate (support level: 30kg rice / 1 person / 1 month).
- Recovering over 70% of agricultural land area is being supported to stabilize life within 12 months if there is no relocation and within 24 months if having to relocate (support level : 30kg rice / 1 person / 1 month).

Allowance for job change and job creation

- *Implementation progress:* compentation of the project must be completed by recover land for construction;
- *Advantage*: compentation has been researched and completed by home specialist and refer to previous projects and near areas. In addition, the report was fully consulted by the people and comments from the relevant agencies so this task was relative completed;
- *Disadvantage*: The potential for compensation for housing, crops and crops is inevitable, and the success of compensation depends largely on the organization of the implementation, which requires active support. and maximum of local government;
- The potential for compensation for housing, crops and crops is inevitable, and the success of compensation depends largely on the organization of the implementation, which requires active support. and maximum of local government
- *Feasibility and effect*: with the analysis are mentioned above, the feasibility and effect on compensation of the project is quite high, overcome the disadvantages of similar projects.

According to Article 20 of Decree 47/2014 / ND-CP on May 15, 2014 of the Government, households and individuals directly engaged in agricultural production stipulated in points a, b, c and d Article 19 Decree When the State recovers agricultural land but is compensated in cash, apart from compensation in cash for agricultural land recovered, it is also supported with training, job change and seeking jobs in cash. more than 5 times the price of agricultural land of the same type in the local land price list for the entire area of agricultural land

to be recovered, the supported area shall not exceed the local agricultural land allocation quota. Specific support levels are set by the provincial People's Committee based on actual local conditions.

Compensation and support for affected households will be made in other reports.

- Implementation schedule: Project compensation must be completed before land acquisition for construction;

4.1.2 In the construction phase

4.1.2.1 Mitigation measures related to waste

In the construction phase of the project, cutting trees, clearing the ground, excavation of foundation, transporting raw materials, erecting tower, etc., will cause certain effects on the environment. Measures to minimize environmental impact in this stage are included in the bidding documents as the required technical conditions to ensure that which will be done by the construction unit and checked by the project owner.

(1) Minimizing air pollution

- Means of transport, machinery, equipment must have and maintain valid operating permission of the Vietnam Register Department, in which the emission standards are determined;
- All vehicles transporting raw materials (soil, sand, cement, stone, etc.) with trunks covered to prevent dust dispersion into the environment; equipment or materials have to be tied carefully complying with the safe regulations for transport. The building contractors have to install and maintain silencers for motorized means if any environment agency or people request;
- The minimum distance from a concrete mixer to the local office or the residential area is 200 m;
- At the construction area of bay, installing temporary fences of brick, wood or plastic to prevent the spread of dust from the construction site to the outside;
- Watering the construction sites and the areas where can generate large dust (roads, material storage area, ...) in sunny days is a necessary measure to limit dust pollution, especially at locations close to the residential area.

Implement progress: The above measures will be implemented in parallel with the construction work;

Feasibility: dust from transportation of materials and construction activities is unavoidable, the above mitigation measures are made effectively in reducing dust and mitigating impact of dust on the surrounding area. These measures are

simple, easy to carry out and have a low cost.

(2) Minimizing impacts on the water quality

1) Domestic wastewater

Wastewater in the construction phase is mainly wastewater of workers. During the construction process, the contractor rents a house near the project area to workers living with the local people. So that, the domestic wastewater will be treated by the existing waste water collection and treatment system.

At the main construction site of wind power plants, transformer stations, the operator plans to arrange mobile toilets for workers, expected to arrange 6 mobile toilets to meet the sanitation needs of the public. construction personnel.

At the widening position, during the process of using the toilet from Vinh Chau 110kV substation

For construction of lines, project construction workers use the local wastewater collection and treatment system.

Figure 4.1 Toilets on construction site

Within a period of 2 months, when the amount of sludge is filled, the contractor will hire the Suction unit or Urban Environment Company to handle.

Figure 4.2 Sanitation water of workers on the construction site is collected and treated in accordance with regulations

2) Overflowing rainwater

- To ensure the construction of the internal roads of the project does not impede rain water drainage in the project area, causing flooding. The project owner has designed internal roads, along the internal roads, will be invested with concrete box culverts and irrigation culverts.
- Therefore, during the implementation of the project, it does not cause flooding impacts on the area.
- In addition, in order to avoid stormwater runoff, it is necessary to bring contaminants into the environment, the project also implements the following measures:
+ Oil and grease storage, materials, machinery are designed with roof and high ground to avoid flooding; earthworks are prioritized in the dry season with the shortest time to minimize rainwater runoff over the area;
+ Build dikes and install water pipes to surrounding canals to avoid the effects of rainwater from contaminants affecting the surrounding environment.

3) Minimizing surface water pollution

According to the analysis of water environmental impact assessment in Chapter 3, surface-water pollution can be minimized by the following measures:

- Prohibit discharge of construction waste (stone, sand, etc.) into rivers, canals, ponds, lakes, wells. Some of these wastes can be used for leveling foundations, the rest will be collected and transported to the defined local landfill of the commune or the district;
- In the construction sites, where there are many of the workers (such as in the construction area for turbine and substation), the building contractors can hire the vicinity households' sanitation facilities for workers using;
- Prohibit discharge of domestic waste from workers into the water sources. The contractors will contract with the local environment company who is responsible for the collection and transport domestic waste to the local landfill.

All the above measures are required in the bidding documents.

Implement progress: The above measures will be implemented in parallel with the construction work.

Feasibility: These measures are simple, easy to implement and have low cost. The mitigation measures are put in the bidding documents as the required technical conditions of the project.

(3) Minimizing impacts from solid waste

Solid waste generated during the project construction includes construction solid waste, domestic solid waste of workers and hazardous waste:

- ❖ Land left by excavation - filling: The entire amount of excavated soil will be used to fill, fill the pit and leveling the station. Therefore, the project does not generate excess land due to construction and excavation.
- ❖ Construction solid waste from construction materials such as steel scrap, brick, stone, cement, etc., which are not discharged into the environment but reused for levelling (brick, stone, cement, etc.) or being sold to scrap dealers (iron, steel, construction materials, etc.).
- ❖ Domestic solid waste:

  The waste of the workers is not much and is collected in the garbage at the construction site. The contractor contracted with the local responsible agency to collect according to the existing waste collection system.

  The process of collecting and treating household waste at the site is as follows:

  - Arrangement container at site;
  - Every day, domestic solid waste is collected and sorted at the waste collection area. The project owner will contract with a competent company in Soc Trang province for collecting and transport domestic solid waste to the hygienic treatment place;

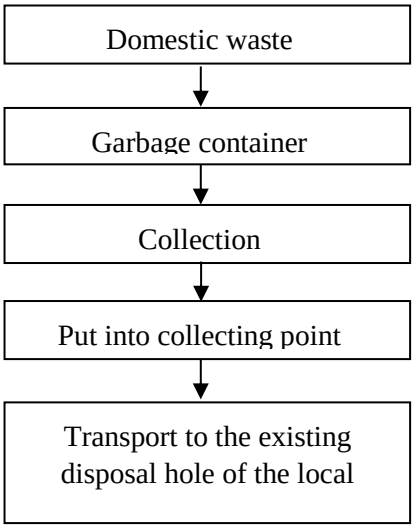


Figure 0.1. Processing of collecting waste

- ❖ Hazardous waste:

Hazardous waste generated during the construction phase will be collected and stored in the storage of the project.

The project owner will arrange some locations for collecting hazardous waste according to regulations of Circular No.36/2015/TT-BTNMT on June 30th, 2015 about practical conditions and procedures establishing registration dossiers, license, management code of the hazardous waste.

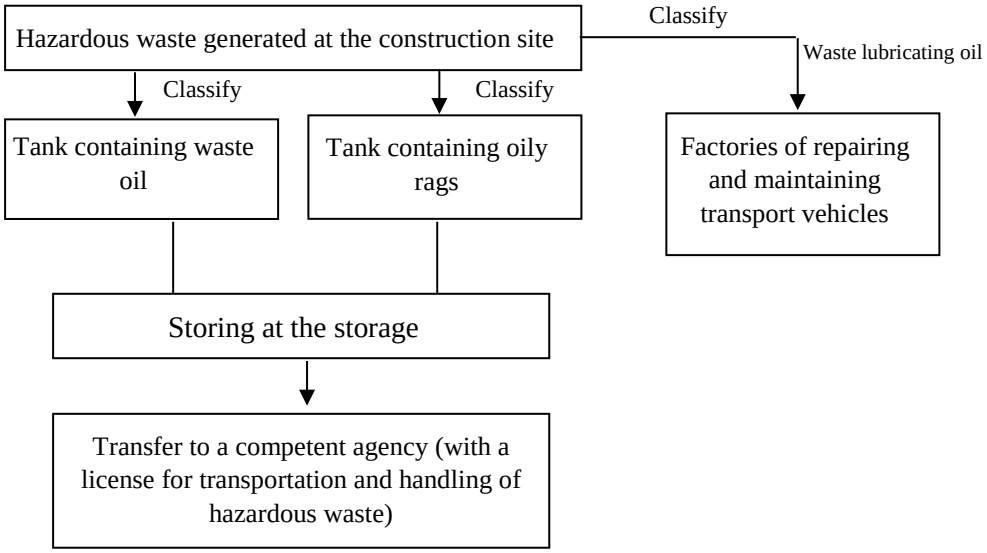


Figure 0.2. Chart of collecting and treatment of hazardous waste during the construction phase

Strong points: These mitigation measures are simple, easy to implement, consistent with the ability of contractors

Weak points:: If the contractors and workers have awareness to maintain and prote ct the environment and implement these mitigation measures, they will bring good efficiency. However, the project owner needs to check the implementation.

Feasibility: The hazardous waste generated during construction is inevitable, and if the mitigation measures are fully implemented, they will bring high efficiency in limiting the negative impacts of hazardous waste on the surrounding environment.

Implementation period: the above measures are implemented in parallel with the construction works.

4.1.2.2 Mitigation measures unrelated to waste

(1) Mitigating impact due to noise and vibration

- In order to reduce noise impact, the method of time planning is the easiest way. It means the project activities should be performed during the daytime and restricted working at night. In case the machines which are too old should not be used because they can cause great noise pollution;
- The noise prevention measures are more positive and flexible than the way which uses sound isolator or absorption silencer for noise sources. However, this method is relatively expensive and not feasible in case noise sources are construction vehicles and machinery (bulldozers, excavator, trucks, agitator trucks, etc.).

- Thus, to minimize noise in the working environment to protect the health of construction workers as well as of the local people living around the project area;
- Machinery and equipment must be arranged for construction works to minimize the collision in the stage of loading and reloading of construction materials.

Implement progress: The above measures will be implemented in parallel with the construction work

Feasibility: noise arising in construction phase is unavoidable. With these mitigation measures, impact of noise could be restricted. These measures are taken into the bidding documents as required technical conditions of the project.

(2) Mitigating impact due to production and living of people

Before conducting construction, it is necessary to inform the ward People's Committee and people,

For households who grow annual crops, aquaculture will compensate after harvesting to minimize the economic impact of the households.

(3) Mitigating impacts on public traffic

For overload and oversize machines and equipment, the transportation process shall comply with Decision No. 63/2007 / QD-BGTVT of December 28, 2007, of the Ministry of Communications and Transport, promulgating regulations on transportation Super-sized, super-weight and crawler-driven vehicles causing damage to road surfaces, over-weighted vehicles, limited road surface. Specific transport project of the project as follows:

- Overload and oversize equipment of the project are mainly turbine bodies, wings and MBA;
- The section of the turbine body is divided into 5 sections, once transported 1 section;
- The turbine wing is divided into 3 transport times.
- 1 Nacelle is transported once.
- 1 Hub is delivered once.
- The project owner contracts with the specialized transport unit to transport the transformer to the site. This transport unit must have a business license and a means of transport suitable to the weight and size of the transformer. The transport means must have a valid technical safety and environmental protection certificate

- On transport routes and bridges: Where the means of transport exceeds the load capacity of the bridge or road, the project owner and the specialized transport unit shall carry out to design and reinforce the bridge, the road to meet the load bearing capacity;
- Installing sign post;
- No gathering materials or establishing a cable stretching yard in the area with high traffic density;
- Limit the time obstructing traffic, arrange workers to guide the traffic when there is a vehicle stopping temporarily on the road for unloading materials and equipment;
- If the existing roads are damaged or degraded due to the project construction, the construction contractor will be responsible for repairing and recovering the damaged roads as the pre-construction status.

Implement progress: The above measures will be implemented in parallel with the construction work.

Feasibility: Transportation of materials and machinery to the project area increases the density and pressure on the existing road network in the area, but the impact is small and minimized by the above measures. These measures are simple, easy to control and included in tender documents and tenders.

(4) Mitigating impacts on ecosystems

General measures

- The investor cooperates with the main contractor to train employees and workers on all rules, regulations and information regarding the protection of biological diversity, as well as disciplinary actions if infringe. Hunting activities for workers and contractors are prohibited;
- Prioritize the use of indigenous trees in planting green carpet trees in the project area after construction.

Specific measures in the wind turbine area

Applying pilling management measures in accordance with the standard piling guidelines of the Committee for Nature Conservation - JNCC (2010), specifically as follows:

- Training for workers and supervisors in charge of piling on Marine Animal Observation and Passive Sound Monitoring during piling;
- Setting Up Isolation Area with a radius of 500m around the pile location;
- Observe 30 minutes before starting;
- Perform Delay-Start procedure if observing marine animals in Quarantine;

- Perform Soft Start procedure (minimum 20 minutes);
- Maintain monitoring records of marine life observed in the project area.

Implementation schedule: the above measures are implemented during construction.
Feasibility: impacts on this ecosystem are small and minimized by the above measures. These measures are simple, easy to control and included in bidding and bidding documents.

(5) Mitigating impacts on the cultural historical heritages

In the design period, the preservation of cultural historical heritages within the area is carefully considered. During excavation and construction process of tower foundations, if any valuable cultural and historical asset underground is detected, the project owner will stop construction works and immediately notify to Department of Culture, Sports and Travelling in Soc Trang province for resolution according to each specific case.

(6) Minimize impact due to concentration of worker

To minimize the negative impacts on the socio-economic environment when gathering a large number of workers at the construction site, the contractor will apply the following measures:

- Logicizing the process of construction, arrangement and distribution of works so that the density of workers at the construction site can be restricted to the minimum;
- The construction contractor will employ local people as many as possible to implement simple tasks to avoid high concentration of workers from other places;
- Provide adequate living conditions for workers such as toilets, drinking water for protecting the hygienic environment around the project area;
- Registration of temporary residence for workers with the local police;
- Propaganda and education for workers, building the relationship with the local people;
- Coordinate with local authorities and local security in order to ensure security;
- Request the construction workers from other areas must respect the local customs and habits, not participate in or cause social evils..

Feasibility: These safety measures are referred to, drawing experience from previous projects. The application of these measures will inevitably limit occupational accidents and protect the health of workers and residents. All these

measures are also included in bidding documents and tenders as mandatory technical conditions.

(7) Solution to clean up the site, temporary ground after construction

Do not implement the construction of camps for construction workers, workers are arranged to rent houses along the line near the construction site.
Clean the surface of the discharge yards after construction and installation of the project; ensuring environmental sanitation in the project area; do not dispose of solid waste into the area; return the status quo to the area.
For construction sites, the storage area shall be cleaned up as follows:

- After completing construction; construction organizations and individuals must clean all construction materials, raw materials, return the ground / site to the ground or temporarily occupied traffic smoothly and safely;
- Before handing over the project, to remove all surplus materials, move machinery, equipment, remove obstacles and repair damage (if any) of the construction work;
- After completing the above tasks, construction organizations and individuals must hand over the site, construction site to site management board and project management board. The handover must be recorded in minutes;
- The project owner must check the actual site; If it is found that the site has not been cleared, the road works or other works / houses have been damaged due to the construction and cannot be repaired or returned to their original state, they may refuse to accept the handover or claim according to the law. If the construction organizations and individuals have fulfilled all the requirements prescribed by law, the project owners shall have to carry out the procedures for receiving the hand-over of sites, sites and management and protection organizations. maintenance according to regulations.

4.1.3 In Operation Phase

4.1.3.1 Mitigation measures related to waste

(1) Minimizing dust pollution

During the operation phase, air pollution source is mainly dust generated in place due to the wind turbines built on the ground, where density of vegetation is very scattered so soil is easily disseminated to the air environment. In this regard, the project owner should conduct the mitigation measure by planting vegetation around the project area to minimize dust dispersal ability in the air environment.

(2) Minimizing pollution due to wastewater

❖ Domestic wastewater

According to TCXDVN 33-2006 of the Ministry of Construction on water supply - pipeline network and construction - design standards, Domestic wastewater generated from activities of 10 workers is: 10 workers x 120 liters/person/day x 80% = 0.96 m^3/day (wastewater discharge = 80% of the amount of supplied water).

Domestic wastewater in 110kV WWP No.3 will be disintegrated partially by the septic tanks. The effects of septic tanks are settling solids, anaerobic decomposition of organic matters and containing sediment. Average treatment efficiency based on the concentration of suspended solids, COD chemical oxygen demand, biochemical oxygen demand BOD_5 from 50 to 70%. The treated Wastewater in the septic tanks will be taken to the domestic wastewater collection tank by the gravity runoff principle. In this tank, ventilation pipes will be installed to regulate the effluent concentration and avoid sedimentation. From there, the Wastewater will be pumped into the preliminary sedimentation tank to remove the residual suspended solids after flowing the septic tanks. Next, the Wastewater will be taken into the biological filter to decompose the remaining organic matter in the wastewater. In the biological filter, organic matter is oxidized by microorganisms (mostly bacteria) including aerobic, anaerobic and arbitrary anaerobic microorganisms in the biological film attaching to the filter material. Part of the clear water after filtered will go into the disinfection tank to kill bacteria, pathogenic bacteria in wastewater, and will reach the standard QCVN 14: 2008/BTNMT, type B, K = 1.2 before being discharged into the receiving water.

Sludge in the sedimentation tanks will be collected and pumped to the sludge compressing tank in the chemical contaminated wastewater treatment system to reduce the moisture content of sludge from 99% to become 97%. Sludge after compression will be transferred to the sludge dewatering tank. Here, the moisture content of sludge will be dropped to 70% and pressed into a solid substance and transported to store in the ash pond of the power plant.

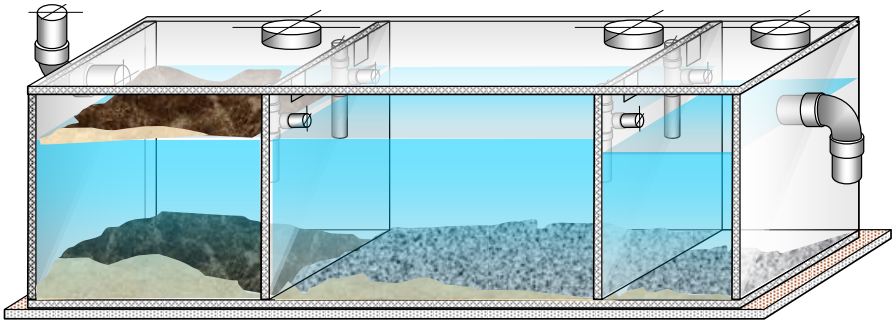


Figure 0.3. Schetch of a septic tank

❖ Manufactured wastewater

Wind Power Plant No 3 is a project to convert wind energy into electricity, the project has no production activities so there is not wastewater.

❖ Overflowing rainwater

- Regularly check, maintain, dredge and clean ventilation system of ditches to discharge flood in the project area.
- At the same time, rainwater runoff through the foundation of the plant area according to the system of drainage ditches to the existing manholes has been completely built, these manholes are connected to the general drainage system of the plant. Rainwater flowing into the general sewerage system of the plant does not contain any harmful components (oil cleaning rags, paint solvent tanks in a separate area with roofs, signs, etc.).

(3) Minimizing impacts from solid waste

❖ Manufactured waste

Solid waste arisen from the process of repair and maintenance of wind turbines, substations, transmission lines includes insulators, conductors, steel piles, damaged accessories, etc. which are also hygienically collected. The project owner will contract with a competent company in Soc Trang province who will collect, transport and dispose domestic waste periodically.

❖ Domestic waste

The quantity of domestic waste is about 2,5 - 3kg/day (0,25 - 0,3kg/person/day x 10 person). The main component of waste including: organic food, plastic bags, cans, paper, …

- Organic compounds such as fruits and vegetables, excess food, ...

- Types of packaging, packages for food, drinks, ...

- Inorganic compounds such as plastic, plastic, glass, ...

- Metal like cans, ...

The waste collection and treatment system at the station is as follows:

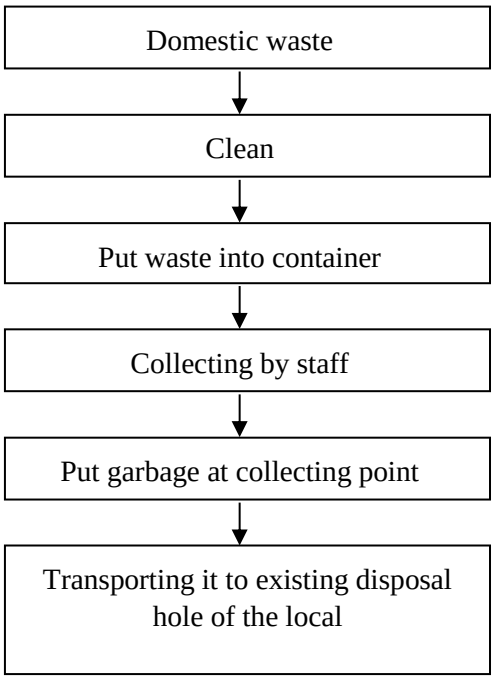


Figure 0.4. Collecting waste diagram

The project owner will contract with a competent company in Soc Trang province who will collect, transport and dispose domestic waste periodically in accordance with the regulations. The domestic solid waste must be transported periodically to dispose, in order to avoid garbage being stored for a long time which will cause anaerobic decomposition, arise smell and become a source of disease spread.

❖ Minimize impact due to hazardous waste

Hazardous waste during operation process include:

- Insulating oil: Maximum 30m^3 only in accident case;
- Cartridge, fluorescent lamps, battery, oily rag, … about 15-25 kg/year.

For MBA oil, it will be sampled for annual inspection, if quality of oil is not satisfactory, the oil will be filtered to improve the quality to ensure insulating properties while also extend using period of oil. The oil filtration process is closed and operated by experienced specialists.

For overflowed oil when the accident occurs, it will be collected to oil container (useful capacity of container is 35 m^3).

The station will contract with the specialized company (have transportation and handle hazardous waste licenses) to transport and handle with regulations on management hazardous waste. Transportation and handling is periodical implemented 6 months/times.

The collection, storage, transportation and handling processes are complied with regulations of Circular No.36/2015/TT-BTNMT date 30/06/2015 of Nature Resources – Environment Ministry about management hazardous waste.

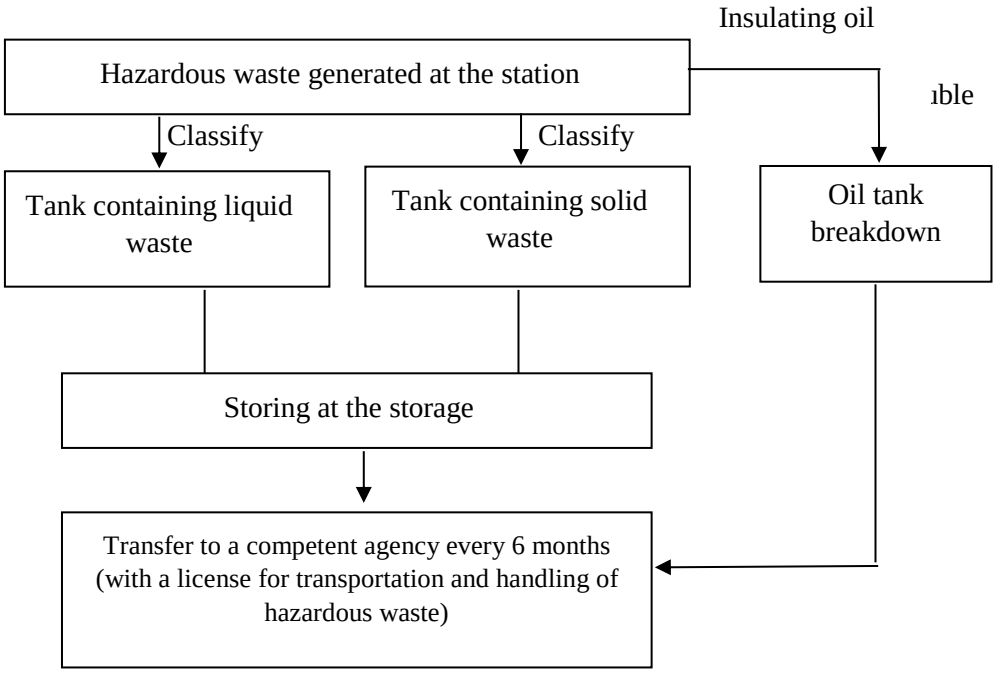


Figure 0.1. Diagram of hazardous waste collection and treatment in operation phase

The process of collecting, storing, transporting and handling complies with the provisions of Circular No. 36/2015 / TT-BTNMT dated June 30, 2015 of the Ministry of Natural Resources and Environment on hazardous waste management. .

Hazardous waste warehouse has an area of 3m x 4m in the area of 110kV substation Wind power No. 3.

Implementation progress: the above measures are implemented in parallel with station activities during operation process.

Feasibility: the above mitigation measures, if implemented will be highly effective in limiting the impact of usual and hazardous wastes to surrounding environment. These measures are simple, easy to implement and low cost.

4.1.3.2 Mitigation measures unrelated to waste

(1) Mitigating impact due to noise and vibration

Periodically checking and maintaining wind turbines, transformers to ensure operation meets the standard of noise of QCVN 26:2010/BTNMT and the standard of vibration of QCVN 27:2010/BTNMT.

According to the result of actual measurement on December 15th, 2009, in the wind power plant project in Binh Thanh Commune, Tuy Phong district, Binh

Thuan province, noise measured at the base of the wind turbine (symbol as FL614) has got the largest value of 45.3 <70 (dBA) to meet the regulated standards so the noise arising from the turbine does not affect the operation workers of the project. In addition, at a distance of 250 meters from the base of the turbine tower, the sound is not heard. Thus, the noise generated from the turbines is negligible in a wide construction range of this project.

Because the machinery and equipment of the substation will be bought completely new so they will be operated in good condition, results of noise measurement indicate that in the operating transformer area, within a radius of 3m, the noise is <70dBA under the allowable standard.

(2) Minimizing the impact of infrasound waves

The project owner will install wind turbines with new manufacturing technology which will limit to arise infrasonic waves, while operation, the wind turbines will arise infrasound waves with frequency from the 20-40Hz (similar to the sound of the leaves rustling), it does not harm human health and the habitat of birds, bats.

(3) Minimize impacts on the ecosystems

In the project area, there is no forest except low wild plants, in addition, the weather in the project area is too hot and harsh so there are hardly the big birds to congregate here. The wind power plant construction will not affect the habitat of birds.

(4) Minimizing shadow and flickering effect caused by blades

❖ Shadow of blade

This impact only occurs in a relatively small radius. The wind turbines of the wind power plant No 3 are far from the residential area and the 2.500kW turbines have very low rotational speed so the flickering effect is negligible.

❖ Magnetic field

The impact of electromagnetic field at the station is evaluated in detail in Chapter 3 is very low than standard. However, in order to ensure safety for operators and surrounding peoples, the project will implement following measures:

- The design, construction, installation of transformers and connection lines comply with current regulations and standards, especially Decree 14/2014/NĐ-CP date 26/02/2014 of The Government ;
- Installation of safety signs at the required areas of the station and along electromagnetic field ;

- Providing labor protection equipment for workers working in areas with high electric field strength;
- Annual health examinations for officials to detect timely occupational disesses and preventive measures, treatment;
- Implementing the hazardous cultivation regulations for officials;
- Supervising electromagnetic field at the TBA area and connective lines.

Implementation progress: the above measures are implemented in design and construction phases and are implemented in parallel with the project activities during operation process.

Feasibility: the above mitigation measures, if implemented, minimize the effect of electromagnetic field in regulation of electricity industry and average cost.

(5) Measures for maintenance the connecting transmission line

Operation Company implements operational work on current regulations of The Vietnam Electricity Group include: safety protection of high-voltage power grid works as rule in Decree 14/2014/NĐ-CP date 26/02/2014 of The Government. Related works include:

- Checking the periodic turbine and connection lines 110KV;
- Checking the safety scale of corridor 8m of connection lines 110KV;
- Checking the safety distance signs when the line crossroads to ensure the safety for triffic vehicles in the line corridor;
- Operating the project comply with safety techniques and regulations on electrical safety and PCCC.

4.1.4 Solutions to minimize prevention to shrimp farmers

During the operation of the project, it is required to comply with the regulations on wind power operation, only to implement the project within the approved scope. Do not affect surrounding shrimp farmers.

4.1.5 Solution for environmental rehabilitation after the project completion

The project owner will restore the current status of temporary occupied area after the completion of construction. This content will be reflected in the bidding documents, which is a mandatory factor for the contractor to implement.

After the end of the project, wind turbines, electrical equipment, lines, transformer stations are solid wastes that need to be treated otherwise it will affect the environment.

- Wind turbines and electronic devices:

Most components of turbines and electrical equipment are made of metal. These wastes will be classified as semi-liquid (for stems, wings, rotors, power cables, etc.) or scrap for unusable types.

Wind turbine foundations will be leveled to the ground, planting trees to return the natural status to the project area.

- Transformer station and 110kV connection line:

Most electrical equipment (porcelain, cutting machines, cutting knives, etc.) and transformers will continue to be used (except for broken equipment that will be replaced) as an intermediate substation to connect other projects in the region to the national grid and ensure the stability of electricity supply to the region. So there will be very little waste.

- Internal traffic system:

The system of built internal roads will be retained to restore people around the area, helping people to travel more conveniently.

4.2 Measures for preventing and response to risk and incident to environment and public health

4.2.1 In the construction phase

4.2.1.1 Measures for safety construction

At the construction site, the project owner always appoint a staff to monitor the labor safety issues. The safety training programs for workers and staffs in the construction site are held periodically. The following measures can be implemented:

- Before working on high positions, workers have to check labor tools and safety belt. These tools should be neat, lightweight, easy to handle;
- Workers mustn't work in high positions when it is dark, foggy, rainy, lightning or wind having level 4 or higher;
- Workers working on the ground have to wear helmets and keep a safe distance in a dangerous position;
- All workers' health are checked periodically to ensure health standards for working in high positions, to be trained for the work they undertake and are propagated procedure on labor safety. In each team with about 30-40 workers, there is a medical staff for care and treatment of common diseases such as influenza, other infectious diseases and first aid for injured workers before moving victims to district health center or provincial hospital.
- Absolutely complying with safety regulations on installation and operation of electric equipment;

- When the transmission line traverses the residential areas (especially where there is high population density), insulation equipment needs to be installed to avoid potential electrical incidents.
- Periodically inspecting and removing of branches of trees which are higher than 6m in the safety corridor;
- Ensuring labor discipline, safety rules and implementing regulations on the labor protection equipment (helmets, gloves, safety belts...);
- Construction area must be isolated by fences and installed warning signs of the area under construction and only let people on duty move around;
- There are drainage systems in the construction sites to ensure no water standing on the construction site and no rainwater or wastewater overflowing into the surrounding buildings;
- Foundation holes on the construction site are covered tightly or enclosed to ensure safety for travellers. Trenches, pits located near roads are enclosed with barrier of 1m in height, there must be signal lights at night;
- For safety of fire prevention and fighting in the construction sites there are tools and fire-fighting materials such as sand, fire hydrant CO2, shovel, etc... and there are also working regulations and fire prevention and fighting regulations;
- Building facilities for food sanitation for workers to limit infections. Providing protection equipment to prevent from noise, vibration and dust for labourers working near the polluting equipment.

4.2.1.2 Safety for erecting towers of turbines

The safety measures while erecting towers of wind turbines, blades and other accessories;

- Construction process must comply strictly with technical design, regulations and procedures of turbine tower foundation construction;
- Machinery and equipment must be checked periodically before operation;
- Before working on high positions, workers have to check labor tools and safety belt. These tools should be neat, lightweight, easy to handle;
- Before mounting equipments, it is necessary to check fastening wire, and cable hooked carefully. The workers are not allowed to stand under the scope of crane operation;
- Installation of electrical equipment and materials must comply with the principles of preventing equipment and materials from scratches and damage;

- Adjustment and testing must be carried out in compliance with specified regulations for each type of equipment and material.
- Construction machines and devices will be checked carefully on quantity and quality before using. Besides construction leader, there is a staff for monitoring safety and environment (if necessary). This staff has responsibility to check tools, protective equipment and guide regularly workers on safety and environmental protection during construction.

4.2.1.3 Prevention of fire incident

- Equipping firefighting equipment at the site such as: sand, CO2, shovels,...At the same time there is table regulations;
- Training and raise workers's sense of Firefighting;
- Checking, maintaining and verifying construction equipments, firefighting equipment in order to be ready for rescue when problems occur.

4.2.1.4 Clearance of mines before construction

The project area was planned and the project owner coordinated with the competent agency to scan and remove residual mines after the war in the region. Thus, there is no effect of residual mines on structures and workers' health.

Rescue measures when incidents occur:

- Find all measures to bring the victims out of dangerous areas, isolate dangerous areas (if any).
- First aid and transfer of victims to the nearest medical center and hospital (if necessary).
- Notify the site leaders, contractors and project owners.
- Notify local authorities and Military Command for coordination.

Clearance of surplus bombs and mines after the war before construction

The project has been planned and coordinated with functional units to conduct clearance of residual bombs after the war in the region. So, the impact of mines and workers' health is safe.

Rescue measures when incidents occur:

- Find all measures to bring the victims out of dangerous areas, isolate dangerous areas (if any).
- First aid and transfer of victims to the nearest medical center and hospital (if necessary).
- Notify the site leaders, contractors and project owners.

- Notify local authorities and Military Command for coordination.

4.2.1.5 Traffic safety

In the construction process, many means of transportation transport materials and equipment into and out of the project area. In order to ensure traffic safety in the area, some of the following measures need to be taken:

- Trucks must meet all technical safety requirements and vehicles must be inspected by functional agencies before they can be put into use. When operating, the driver must follow the traffic laws, when entering the project area, follow the operator's instructions for the direction, location, loading, etc.
- Limitted transportation during rush hours with high traffic density
- Project owners and construction contractors must arrange time for transportation of raw materials and equipment in order to avoid traffic congestion in the area.
- At the access roads to the project area, there must be signboards with regular motorized means of transport, signs in sections and in dangerous sections.

4.2.2 During the operation phase

4.2.2.1 Prevention of insulating oil leakage from transformers

- Track signs of oil leakage from transformers in each shift;
- When detecting oil leakage, immediately isolate the site (if necessary) and use oil-absorbent paper or wiping cloth to thoroughly handle the oil leakage on the surface;
- MBA engineering inspection, in case of necessary troubleshooting;
- Oil-cleaning rags and oil-absorbent paper are concentrated on labeled containers and lids at hazardous waste storage areas of stations.

4.2.2.2 Prevention of insulating oil spill from transformer when there is a fire or explosion problem

- The insulation oil from the transformer will be collected to the oil collection tank when it is in trouble. Incident oil collection tank of station with reinforced concrete bottom and walls (grade 200) poured in place, prefabricated reinforced concrete cover. Storage capacity of the tank is 35 m3, enough to accommodate all of the spill and firefighting water in case of incidents according to current regulations (Electric equipment regulations 11 TCN-20-2006 - Article III .2.76, sections 6 and 7).

Calculation of incident oil tank volume:

According to Electrical equipment regulations 11 TCN-20-2006 (Article III.2.76, Section 6 and 7), the incident oil collection tank must ensure the storage of all oil of the equipment with the largest oil quantity and the amount of treated water. burn for 0.25 hours (15 minutes) when the problem occurs.

(i) Maximum oil quantity:

Incident oil tank is designed to collect insulating oil in case of trouble of 40MVA transformer. According to the fabrication, the oil volume in the 40MVA transformer, the oil volume will be 20.47 m^3.

(ii) The amount of firefighting water within 0.25 hours (15 minutes):

- The amount of water in the case of fire is calculated according to the formula:

$VH2O = S \times I_2$ (m^3 / h)

Inside:

S: total surface area of transformer bags = 104m^2;

I2: fire water rating, 0.18 m^3 / m^2 / h.

VH2O = 104 m^2 × 0.18m3 / m^2 / h = 36.72 m^3 / h = 4.68 m^3 / 15 minutes

Since then, the total volume of oil and the amount of fire water in 15 minutes is: 20.47 m^3 + 4.68 m^3 = 25.15m^3.

Thus, the volume of the incident oil tank is chosen to be 35m3, completely able to contain the amount of spill and fire water in case of incidents according to current regulations (Electric equipment regulations 11 TCN-20 -2006 - articles III.2.76, sections 6 and 7).

The process of oil collection and oil treatment when incidents occur is implemented as follows:

- On the MBA tank, there is a self-release pressure valve. When a fire or explosion incident occurs, only a certain amount of oil spills out, there is almost no case of completely discharging the transformer oil;
- Then, the oil spill will be led into the oil collection tank with oil collecting hole and steel pipe Φ200, and around the transformer holder that has built reinforced concrete embankment of 1 × 2 M200 to avoid the phenomenon of oil spilling around;

Measures to rescue when leaks and oil spills occur:

- Alerted everyone to join in extinguishing the fire in their capabilities and conditions;
- Quickly disconnect the breaker where fire occurs;
- Use fire protection tools at stations such as sand, CO2 tanks, shovels, ... and water to extinguish the fire;
- Immediately report to the professional firefighting force for firefighting;

- Notify the Head / Deputy Head;
- Isolate the oil spill area;
- Notify the unit capable of handling and collecting, transporting and handling the amount of oil and fire water in the oil reservoir;
- Use materials such as sand, oil absorbent paper, cleaning cloth, ... to thoroughly remove the oil in the tank to ensure the amount of rain water then flow into the oil-free;
- Oil-cleaning rags and oil-absorbent paper are concentrated on labeled containers and lids at hazardous waste storage areas of stations.

4.2.2.3 Electrical safety measures, lightning protection

For lightning protection and insulation of wind turbines and transformer stations during the operation of the project, the following measures are applied:

- Lightning protection system: protection against lightning strikes directly at stations and turbines with lightning collecting needles;
- Grounding system: using a combination system of bar piles to form square grounding grid, grounding grid using Φ12 galvanized steel and grounding piles. Lightning collecting needles, gate columns, beams, equipment pillars, equipment, electrical cabinets grounded with Φ12 galvanized steel and M95 copper wires;
- The equipment and machinery used in the project have an accompanying resume, complete with technical specifications and regularly inspected and monitored;
- The project is equipped with fire-fighting tools such as water tanks, CO2 tanks and sand barrels and fully fulfills the fire prevention requirements of the local fire prevention and fighting agencies.
- During operation, when there are incidents, the protection relays are placed in the station and on the connection line automatically disconnects the circuit to ensure safety for the station and the line.

4.2.2.4 Prevention, rescue of incidents and fire safety

- Fully equipped with fire protection and fire fighting system at the specified station (fire fighting water source, fire fighting equipment such as pump station, fire hydrant, sprinkler, misting system, fire extinguisher CO2, sand ball, newspaper, etc.);
- To ensure electrical safety in the station, the distance of installation and distance to the conductive circuits comply with the current electrical equipment rules. Equip safety signs and barriers;

- Establish an action team to respond to incidents when there is a fire;
- Regularly rehearsing, inspecting and maintaining fire prevention and fighting equipment;
- Raising awareness of officials and operators on fire prevention and fighting issues;
- In addition, combine with the local fire protection team to respond in case of necessity.

Rescue measures when a fire incident occurs:

- Alert people to join in extinguishing the fire in their capabilities and conditions;
- Quickly disconnect the breaker where fire occurs;
- Use fire protection equipment at stations such as sand, CO2 tanks, shovels, ... and water to extinguish the fire;
- Immediately report to the professional fire fighting force for fire fighting (if necessary);
- Notify the Head / Deputy Head.

4.2.2.5 Prevention of falling head of turbine, subsidence

- Surveying geological area fully and in accordance with technical requirements before construction.
- Foundation design, column based on geological survey results refer to geological documents of the project area and surrounding locations.
- The construction process complies with the design and regulations, technical process of construction of foundation piles.
- Periodically check the quality of works, promptly overcome subsidence incidents.
- When problems occur, the relays automatically disconnect and the alarm system will work. At that time, the operators quickly went to the scene to settle.

4.2.2.6 Preventing occupational accidents

- Fully complying with safety technical procedures when conducting work at the factory;
- Periodically organize training sessions to improve the professional qualifications of plant operators;
- All work in the factory must perform "Work tickets";

- Must seriously implement the normative process and work orders;
- Must be fully equipped with personal safety: clothes, shoes, latex hats, ...
- Strictly forbid to drink alcohol or other stimulants before and during working hours;
- Prohibit to work high when there is a level 4 wind, heavy rain with heavy particles and lightning;
- When working, it must be very focused, not playful, work carefully with the right process, right technique, be careful and correct.

4.2.2.7 Prevention of disaster risks

- Improving management capacity, commanding, implementing measures to prevent, combat and respond to natural disasters for the project management and operation unit.
- Check, consolidate and promptly remedy the problems of equipment, foundations and turbine columns, power stations, lines to ensure safe operation of the grid during the rainy season.
- To be ready for forces, means and equipment for permanent organization to receive and process incident information and overcome repair of turbines, stations, foundations, power lines and lines when incidents occur. .
- Develop plans, plans, materials and resources to restore power supply safely, quickly and support other units after natural disasters, storms, ... occurred.
- Organize exercises in situations of natural disaster and storm prevention, note the situation of flooding, flooding, and divided areas.
- Strengthening propaganda and warning on electrical safety in the rainy season for people.

4.2.2.8 Preventing construction subsidence, downfall, broken rope

- Design of transformer foundation and foundation based on geological survey results with reference to geological documents of station area and surrounding locations.
- The construction process complies with the design and regulations and technical process of foundation construction.
- Periodically check the quality of works, promptly overcome subsidence incidents.
- When the line breaks, the relays automatically disconnect the power and the alarm system will work. At that time, the operators quickly went to the scene to settle.

Measures of inspection, supervision and rescue when landslide incidents and subsidence occur:

- Notify the team and Head / deputy station.
- Stop activities related to subsidence.
- Conducting inspection, repair and troubleshooting.
- After repairing and overcoming, it is necessary to continue the activities related to the project.

4.3 Schemes for organizing the implementation and measures for environmental protection

4.3.1 Funding for implementing environmental protection

(1) In the construction phase

- 02 (60-liter) garbage cans: VND 1,000,000

- 06 mobile toilets: VND 12,000,000

- Funds for solid waste collection during the construction process: VND 5,000,000 / month;

- Expected budget for implementation of environmental monitoring report: VND 50,000,000 / year (included in the investment cost of the project).

(2) In the operation phase

Costs of environmental protection works and measures in the operation phase are as follows:

- Arranging 03 hazardous waste containers: VND 1,500,000

- Septic tank treating domestic wastewater: VND 50,000,000.

- Drainage system in the station: VND 50,000,000

- Incident oil collection tank: VND 100,000,000.

- Hazardous waste storage area: VND 10,000,000.

- Equipping fire protection equipment: VND 80,000,000

These costs are within the construction investment cost of the project.

In addition, the annual cost of environmental monitoring operation period is 50,000,000 VND / year.

4.3.2 Arranging implementation as follows:

Table 0.1. Implementation Arrangement

Role	Responsibility	Responsible agency
Project owner	Responsible for overall project management, guide and conduct environmental management plan implementation	BPP Vinh Chau Wind Power Limited Liability Company
	Specific responsibility and contact for environmental issues	
	Responsible for detailed implementation. Activities are included: - Planning and implementation of environmental management activities during construction - Coordinating with other parties in relation to environmental management activities. - Supervising and providing budget for monitoring activities. - Reporting on environmental information to concerned parties.	
Project Operator	Responsible for operation of the project including environmental management and monitoring activities in operation phase.	BPP Vinh Chau Wind Power Limited Liability Company
Consultant	Responsible for consulting, preparation EIA report and submit to the People's Committee of Da Nang city for appraisal and approval.	The Power Engineering Consulting Joint Stock Company 3
Construction Supervision	Responsible for supervision of Construction Contractors during construction, including implementation of environmental management activities under the EIA	BPP Vinh Chau Wind Power Limited Liability Company
Construction Contractor	- Applying mitigation measures during the construction phase; - Ensuring safety for construction workers and local people during construction.	BPP Vinh Chau Wind Power Limited Liability Company

CHAPTER 5 ENVIRONMENTAL MONITORING AND MANAGEMENT PROGRAM

5.1 Environmental management program

The environmental management program during the preparation, construction and operation phases of the project is summarized in Table 5.1 below:

Table 0.1. Environmental management program of project

No.	Activities	Environmental Impacts	Measures to protect environment	Cost	Execution and completion time	Execution Responsibility	Monitoring Responsibility
1. PRE-CONSTRUCTION							
1.1	Clearance	Solid waste such as trees	- Limited chopping unnecessary tree; - Collecting and utilizing trees, cut flowers to make wood or firewood, the rest will be transported by the investor and the construction unit to the local waste collector for transportation	Including in construction cost	Execution and finish before construction activities	Contractor	Project owner
1.2	Compensation and support for local people	Impact on local people due to loss of productive land.	- Compensation has to obey current regulations and approval decisions of the People's Committee. - Compensation must be open and obvious	Cost for compensation and allowance comply with regulations	Execution and finish before construction activities	Project owner and Compensation Council	-
2. CONSTRUCTION PHASE							
2.1	Activities of ground leveling, excavation	Noise, dust and emission gas from excavation activities and vehicles will cause negative impacts on air environment.	- Means of transportation should have the certificate of authority. - The vehicles should be fully covered by plastic to prevent the spreading dust to	Including in construction cost	During construction period	Contractor	Project owner

No.	Activities	Environmental Impacts	Measures to protect environment	Cost	Execution and completion time	Execution Responsibility	Monitoring Responsibility
	and material transportation		environment. - Transportation of devices, materials and heavy equipment must use specialized vehicles. Loads, fastening wires must be checked before use. - Watering during construction period especially in hot days.				
		Increasing force to local traffic and damage on road's surface.	- Arranging reasonable time to avoid traffic jams. - Using specific means to transport overload and oversize equipment, machine. - Repairing damage roads due to transporting project's equipment.				
2.2	Using machine, equipment to construct	Noise of machine affect to the local	- All construction activities carry out during day. - Using machine and equipment with low noise. - Just push corn in necessary case. - Limiting transportation at night	Included in construction cost	During construction phase	Contractors	Project owner
		Construction waste is mainly soil, stone, scrap iron, cement bag and scrap timber. If they are not disposed in appropriate place, they will impact on natural landscape of the area.	- Collecting solid waste, material, ect. at the construction site. - Building isolated fence for the construction sites. - Restoring landscape after the construction finished				

No.	Activities	Environmental Impacts	Measures to protect environment	Cost	Execution and completion time	Execution Responsibility	Monitoring Responsibility
2.3	Construction of substation and turbine foundation	Generating construction waste such as rock, steel, cement bags and soot if waste is not properly collected, it will affect the natural beauty of the area.	- Collecting solid, material waste, … at site. - Separating waste to recycle and disposal properly. - Ensuring restore initial landscape when accomplish construction.	Included in construction cost	During construction phase	Contractors	Project owner
2.4	Concentration of workers	Domestic waste of workers will impact on natural landscape and environmental water and soil if it is not collected properly. Domestic wastewater of workers will impact on water if it is not treated before discharging.	- Do not discharge construction waste (stone, sand ...) into the water source. These types of waste are used to level the foundation, the rest are collected and transported to the designated area. - Preventing disposal of household waste from camp and site into water sources. Domestic wastes will be collected and collected at the gathering area and transported and handled by the local waste collection team. - Arrange 06 portable toilets to collect workers' waste water. - Periodically every 2 months will hire an urban environmental company to process	Included in construction cost	During construction phase	Contractors	Project owner
		Workers from the other places might conflict with local people.	- Develop discipline rules for all workers on site - Informing, coordinating with local authorities to manage the people who work in the project to avoid the emergence of social evils, reduce the conflict between local workers and people in the area.	Included in construction cost	During construction phase	Contractors	Project owner

No.	Activities	Environmental Impacts	Measures to protect environment	Cost	Execution and completion time	Execution Responsibility	Monitoring Responsibility
2.5	Risks, incidents	- Labor accident; - Fire, explosion incidents.	- Applying safety measures to construction activities. - Equipping facilities for fire protection on site. - Raising awareness of workers on fire protection; - Check, maintenance periodically all equipment for fire protection.	Included in construction cost	During construction phase	Contractors	Project owner
3. OPERATION PHASE							
3.1	Operation of transformer	Noise of transformer might affect to surrounding area.	- The noise level requirement of the transformer in operation (<70dBA at a distance of less than 3m) shall be clearly stated in the bidding dossier. During the bidding process, this noise level requirement is considered as other required technical conditions. - Inspect and maintenance the transformer periodically to ensure that the transformer meets the standard.	Included in operation cost	During operation phase	Contractors	Project owner
		Oil waste.	Waste oil (if any) is collected and transported by the competent company comply with hazardous waste regulations. Hazardous waste is then collected into hazardous waste storage	Included in operation cost	During operation phase	Contractors	Project owner

No.	Activities	Environmental Impacts	Measures to protect environment	Cost	Execution and completion time	Execution Responsibility	Monitoring Responsibility
3.2	The other activities	Generated waste ink cartridges, waste lamps, waste batteries, oil mop, etc. If not collected and treated, it will affect the quality of land, water in the area	The operator will contract the competent company to collect and transport these wastes comply with hazardous waste regulations.	Included in operation cost	During operation phase	Contractors	Project owner
		Magmatic field at substation will affect to operating staff's health.	- Provide labor protection equipment for workers working in high intensity electromagnetic fields - Annual health examinations for officials and employees to promptly detect occupational diseases and provide preventive and treatment solutions. - Monitoring magmatic field periodically at substation.	Included in operation cost	During operation phase	Contractors	Project owner
3.3	Daily activities of operating staffs	Generated domestic wastewater and waste, if it is not properly collected and treated, the beauty of the area will lose and the risk of causing pollution of the water and soil environment.	- Domestic wastes will be collected and put at the collecting area of the substation and disposal to the existing system in the locality. - Wastewater of staffs will be treated by septic tank before discharging to environment.	Included in operation cost	During operation phase	Contractors	Project owner
3.4	Risks, incidents	- Labor accidents; - Fire, explosion; - Sinking facilities; - Transformer problems.	- Applying safety measures to operation and	Included in operation cost	During operation phase	Contractors	Project owner

No.	Activities	Environmental Impacts	Measures to protect environment	Cost	Execution and completion time	Execution Responsibility	Monitoring Responsibility
			management activities; - Establishing the responded team; - Regular firefighting practice; - Check, maintenance equipment of fire protection; - Raising awareness of workers on fire protection - Design transformer bases on the basis of geological survey results of substation and surrounding area. - The process of construction is in compliance with the design and technical regulations and procedures for foundation construction. - Periodically check the quality of facilities, timely overcome the occurrence of subsidence occur. - Constructing the oil tank to contain oil waste in problem case.				

5.2 Environmental monitoring program

Environmental Monitoring Plan is one of the important contents in environmental quality management and impact assessment during the construction and operation phases of the project to the environment. The evolution of environmental quality can help to redefine forecasts in the EIA or the level of discrepancy between the calculation and reality.

In order to ensure that all activities of the project during the pre-construction, construction and operation phases will not cause negative impacts on the environment and to assess effectiveness of the mitigation measures, the environmental pollution monitoring program of the project, which is managed and supervised by Department of Natural Resources and Environment, will be implemented during the construction and operation phases.

5.2.1 Monitoring environmental in construction phase

BPP Vinh Chau Wind Power Limited Liability Company is project owner and responsibility to carry out measures to protect and monitoring environment during construction period.

Project owner will contact the competent company to monitoring environment as follows:

❖ Monitoring solid and hazardous waste

- Content: monitoring procedures of solid waste collection, management and treatment; Supervising the collection, storage and transfer of hazardous waste;
- Position: 4 construction site;
- Monitoring frequency: 3 months per time;
- According to: Decree 38/2015/NĐ-CP and Circular 36/2015/TT-BTNMT, Circular 08/2017/TT-BXD.

❖ Monitoring the implementation of environmental protection measures

- Content: environmental protection measures during construction phase;
- Position: construction site.
- Monitoring frequency: 6 months per time;
- According to: QCVN 26: 2010 / BTNMT - National technical regulation on noise.

5.2.2 Monitoring environmental in operation phase

The project owner will be responsible for implementing environmental protection solutions and environmental monitoring during the operation phase.

The project owner will be responsible for implementing environmental monitoring as follows:

❖ Monitoring solid waste and hazardous waste

- Contents: monitoring monthly arising volumes, measures and frequency of collection, storage and handover of common solid waste and hazardous waste;
- Position: operator;
- Monitoring frequency: every 3 months;

❖ Monitoring wastewater

- Monitoring content: monitoring the effluent of septic tanks;
- Monitoring position: operator (GNT1), 110kV substation (GNT2);
- Monitoring frequency: every 3 months;
- Monitoring parameters: BOD5, TSS, Ammonium, Nitrate, Phosphas, Total coliforms.
- Regulations comply with: QCVN 14: 2008 / BTNMT.

➢ Electrical field monitoring:

- Quantity: 02.
- Position: In the substation and under the 110kV connection line.

  + GSVHE1: At 22 / 110kV substation wind power plant No. 3

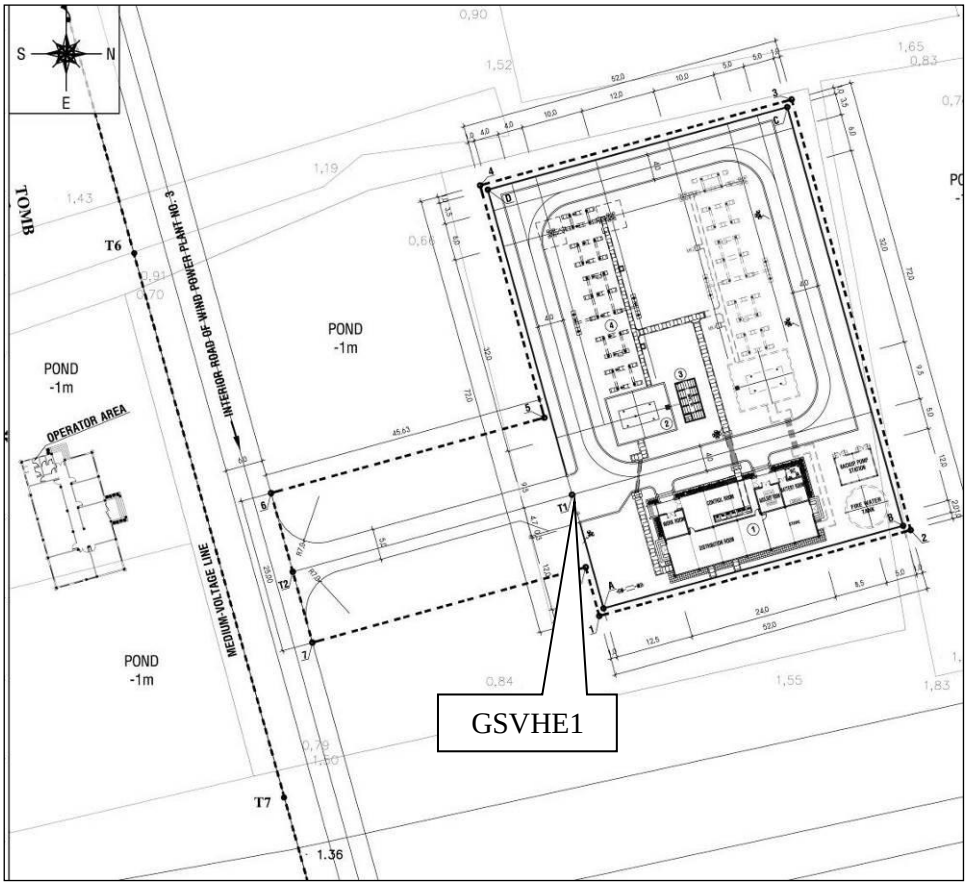
  + GSVHE2: location of 110kV connection line.

- Frequency: 1 year / time.
- Regulations follow: Decree 14/2014 / ND-CP dated February 26, 2014.

➢ Noise monitoring

- Contents of supervision: monitoring noise during operation;
- Monitoring position (GSVHO): at 7 locations of turbine, operator, shrimp farming area of Vinh Thuan Company, near the people's houses;
- Monitoring frequency: every 6 months;
- Regulations comply with: QCVN 26: 2010 / BTNMT - National technical regulation on noise.

Figure 5.1. Diagram of monitoring position in the construction phase



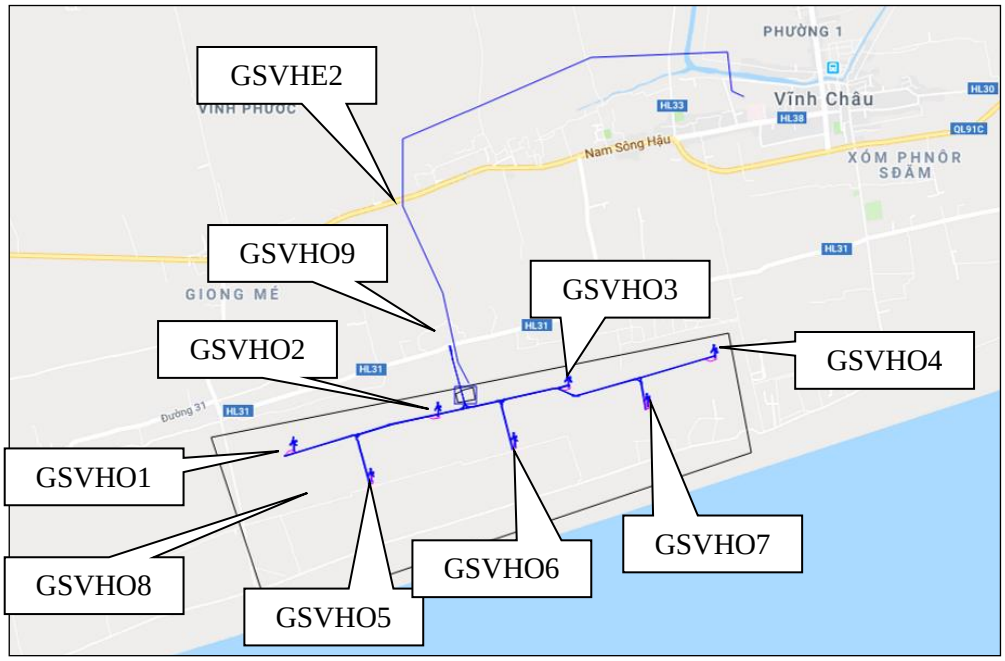


Figure 5.2. Diagram of monitoring position in the operation phase

5.2.3 Estimated cost for environmental monitoring program

Construction phase

- Cost of collecting waste: 5.000.000 VND
- Cost of environmental report: 25.000.000 VND/year.

Operation phase

Cost of one-year monitoring as follows:

- Cost of other monitoring = 3.000.000 VND/year.
- Cost of reporting and submitting = 10.000.000 VND/year.

In the operation period, the cost of environmental management for the operation of the plant is 13.000.000 VND/ year. The operating unit is the responsibility to paid the monitoring fee and comply with the regulations.

CHAPTER 6 PUBLIC CONSULTATION

According to Decree 18/2015/NĐ-CP date 14/02/2015 and Circular 27/2015/TT-BTNMT date 29/05/2015. The project owner has writtens BPPVC19002V date 06/03/2019 regarding to get comment of public consultation during reporting environmental impact assessment Vinh Phuoc ward, ward 1 People's Committee.

The project owner received feedback writtens from Vinh Phuoc ward, ward 1 People's Committee for project's comment consultation.

6.1 Summarize public consultation process

6.1.1 Summarize consultation process with Commune People's Committees and Organizations are directly affected by the project.

According to Decree 18/2015/NĐ-CP date 14/02/2015 and Circular 27/2015/TT-BTNMT date 29/05/2015. The project owner has writtens BPPVC19002V date 06/03/2019 regarding to get comment of public consultation during reporting environmental impact assessment Vinh Phuoc ward, ward 1 People's Committee. The project owner received feedback writtens 46/UBND-HC date 19/03/2019 Vinh Phuoc ward People's Committee and 49/UBND date 19/03/2019 ward 1.

6.1.2 Summarizing about the public consultation with affected people

Project owner have coordinated with affected commune to determine affected people and invite them to the public consultation.

Meetings at Vinh Phuoc Ward People's Committee:

- Meeting location: Vinh Phuoc Ward People's Committee;
- Meeting time: 8am on March 19, 2019
- Ingredient:

+ Vinh Phuoc Ward People's Committee:

Full name	Position
Dao Cong Chuong	Chairman of Ward People's Committee
Nguyen Hoang Bao	Vice Chairman of Ward People's Committee
Huynh Hai Dang	Cadastral officer
Huynh Van Luong	Chairman of the Veterans Association
Luong Thi Bich Xuyen	Chairman of the Women's Union
Duong Ho Vu	Chairman of the Farmer
Tran Tu Trinh	Secretary of the Youth Union

+ Project owner:

Full name	Position
Samicha Pinyocheep	Technical staff
Aposara Sukdung	Technical staff
Tran Minh Nhan	Technical staff

+ Household representative: 18 households

Meetings at Ward 1 People's Committee:

- Meeting location: Ward 1 People's Committee;
- Meeting time: 2pm on March 19, 2019
- Ingredient:

+ Ward 1 People's Committee:

Full name	Position
Han Van Hoa	Chairman of Ward People's Committee
Mai Son Tung	Cadastral officer
Lon Van Hung	President of Vietnam Fatherland Front
Nguyen Thanh Dung	Vice chairman of the Veterans Association
Van Thi Bich Lieu	Vice chairman of the Women's Union
Trinh Van Hung	Head of Department of Natural Resources and Environment of Vinh Chau town

+ Project owner:

Full name	Position
Samicha Pinyocheep	Technical staff
Aposara Sukdung	Technical staff
Tran Minh Nhan	Technical staff

+ Household representative: 05 households

- Content of the meeting:

+ The project owner presents an overview of the project, impacts on the environment and society when implementing the project, measures to protect the environment and policies on compensation and site clearance social birth;
+ Local authorities and households give questions about the project content and contribute ideas to the project;
+ The project owner answers questions and receives feedback from the community.

The written opinion of the Ward People's Committee consultation results is attached in Appendix IV of the Report.

Organize meeting at Vinh Phuoc Ward People's Committee

Organize meeting at Ward 1 People's Committee

Figure 0.1. Organize community consultation

6.2 Result of public consultation

6.2.1 Comments of commune-level People's Committees and organizations are directly affected by the project

6.2.1.1 Comment of Vinh Phuoc ward People's Committees.

Vinh Phuoc Ward People's Committee has a written No. 46/UBND-HC dated March 19, 2019, the following contents:

- Project owners must compensate affected households according to the provisions of law;
- Must commit to implement measures and solutions to minimize the negative environmental impacts of the Project;
- Must ensure safe electromagnetic field during transport.

6.2.1.2 Comment of ward 1 People's Committees.

Ward 1 People's Committee has a written No. 49/UBND dated March 19, 2019, the following contents:

- Project owners must compensate and support affected households according to law provisions;
- During construction, safety and environmental hygiene must be ensured;
- During operation, there must be measures to protect safety for turbines, ensure electric field safety in transformer stations.

6.2.2 Comment of representative of local community are directly affected by the project.

Comment of representative of local community are directly affected by the project as follow:

- Requesting the project owner to take measures to overcome air pollution by the transportation of raw materials.
- In the construction process, if there is an impact on the people's aquaculture land, the project owner is requested to overcome and support.
- Requesting the project owner to implement quickly to minimize damage for local people.
- Requesting the project owner to commit to implement fully the environmental mitigation measures of the proiect .

6.2.3 Feedback and commit of the project owner for proposals and requests of agencies, organizations and local community are consulted.

Explaining comments of Phuong Hai, Tan Hai, Bac Phong Commune People' Committees and local community are affected after consultation. The project owner explained as follow:

- The project owner commit implements fully the environment mitigation measures during construction and operation processes;
- Publishing the project information to the authorities and local people by clearance;
- Compensating appropriately and supporting to local people are affected by the project;
- Construction works, contractor commit to comply with regulations of the law on environmental protection;
- Constructing the project on time, clean up and return to the initial status when the project ends each item;
- Implementing safety labor and safety fire measures when construction as well as operation processes of the project;

- Ensuring repair the damage, if construction and operation processes affect the environment.

CONCLUSION, RECOMMENDATION AND COMMITMENTS

1. CONCLUSION

- Main work items of the project include:

➢ Wind Turbines

- Support tower for every wind turbine with a design height of 100m;
- Turbine diameter: 150m;
- Capacity of turbine: 4.2 MWh;
- Control room.

➢ 22/110kV substation

- Step-up transformer 22/110kV and control house, area: 0.48848ha;

➢ 22kV transmission line and 110kV connection line

- 22kV internal power network 29,961km length;
- 110kV connection line 5.8km length.

➢ Internal road system to support constructing and operating phase 4.996km length.

➢ Expansion of outgoing feeder at existing 110kV Vinh Chau substation, area 0,20007ha

After conducting the study of environmental status, assessing environmental impacts on the natural, economic and social environment, the main impacts of wind power plant No.3 can be summarized. is as follows:

In the preparation phase of construction:

- Affecting and cutting down about 15 longan and 30 other trees.
- Permanently recover 102,200m2 of land for project construction.
- There are 12,639.0 m2 of affected land to reduce the usability due to being located under the safety corridor of the line.
- No households have to relocate.
- There are 15 houses / structures located under the safety corridor. These houses / structures are not relocated, will be supported by the project owner to cover the cost of earthing or renovating the houses / structures to continue to exist under the safety corridor (8m, from the center to each exit). 4m side).
- Temporary influence of 1,345 ha of land for construction.

During the construction phase:

- The transportation of materials and construction activities will cause dust and noise affecting the surrounding environment, but this effect is moderate and only temporary;
- The concentration of construction workers will generate domestic and domestic solid waste. However, the project will arrange mobile toilets and domestic solid waste to be collected, transported and treated like the existing local system.

In operation phase:

- Operation of transformers and other equipment in the station generates noise and electromagnetic fields affecting the health of the operators. In addition, hazardous wastes such as print cartridges, waste batteries, and waste lamps can be generated, however, small and irregular volumes will be collected, stored and transferred to the unit. professional handling according to regulations;
- Operation of operating staff (10 persons) will generate domestic and domestic solid waste. However, small quantities are collected, transported and processed by the local waste collection team (for domestic solid waste) and treated with septic tanks before following the general drainage system of the station. flowing into the environment (for domestic wastewater);
- There may be incidents such as labor accidents, fires, ... causing damage to people and property.
- From the above characteristics, it is possible to assess the level of environmental impact of the project in the preparation phase of construction, construction and operation is small. The negative impacts of the project can be completely overcome and controlled by the mitigation measures outlined in the report.

2. PROPOSITION

The project of socio-economic benefits that the project brings is great, especially promoting socio-economic development for the Vinh Chau town, Soc Trang province in general. Therefore, the implementation of the project is necessary because it suits the development needs of the country.

Proposing Soc Trang Provincial People's Committee to review and approve the EIA report of the project; Proposing the Provincial People's Committee and local departments to continue to coordinate with the Project Owner to monitor the implementation of proposed environmental impact mitigation measures during construction and operation phases to ensure objective of economic development and environmental protection.

3. COMMITMENT

1. The project owner commites implementing mitigation measures for negative impacts described in chapter 4. In additional, project owner commites implementing all measures, regulations on environmental protection related to project developement and implementation

2. National Regulations are applied in this EIA report as:

   - Environmental Protection Law of the Socialist Republic of Vietnam No.55/2014/QH13 on June 23rd, 2014 was passed by the National Assembly;
   - Electricity Law No. 28/2004/QH11 was approved on December 03rd, 2004 by the National Assembly of the Socialist Republic of Vietnam;
   - Decree No.18/2015/ND-CP on February 14th, 2015 of the Government on Environmental protection planning, Strategic environmental assessment, Environmental Impact Assessment and Environmental Protection Plans;
   - Decree No.38/2015/ND-CP on April 24th, 2015 of the Government on Management of Waste and Discarded materials.
   - Decree No.14/2014/ND-CP on February 26th, 2014 of the Government on Stipulating in detail the implementation of electricity law regarding electricity safety.
   - Circular No.36/2015/TT-BTNMT on June 30th, 2014 of the Ministry of Natural Resources and Environment on Management of hazardous wastes.
   - Circular No.27/2015/TT-BTNMT on May 29th, 2015 of the Ministry of Natural Resources and Environment on Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Plans.
   - QCVN 14:2008/BTNMT – National technical regulation on domestic wastewater;
   - QCVN 19:2009/BTNMT – National Technical Regulation on Industrial Emission of Inorganic Substances and Dusts;
   - QCVN 24:2016/BYT – National Technical Regulation on noise - permissible exposure levels of noise in the workplace;
   - QCVN 26:2010/BTNMT – National Technical Regulation on noise;
   - QCVN 27:2016/BYT – National Technical Regulation on vibration - permissible levels of vibration in the workplace;
   - QCVN 40:2011/BTNMT – National Technical Regulation on Industrial Wastewater.

3. Environmental supervision, monitoring program and training program on environmental safety will be implemented in construction and operation phases; and their budget will be ensured by the project owner.

4. The project owner ensures that information of environmental incident will be announced on time and will compensate for damages caused by the project.
5. The project owner commits to carry out the full content in the EIA report approved and the mandatory requirements in the EIA approval decision.
6. Project owners commit to compensate in case of causing damage to households during the project implementation.
7. The project owner commits to using raw materials and materials in the construction process from lawful sources.
8. The project owner complies with the commitment in the meeting with the people on environmental protection during the project implementation and notes the recommendations of the Border Guard Command.
9. The project owner complies with the commitment when implementing the project, the project owner will comply with the provisions of Directive No. 04 / CT-UBND dated 10 April 2018 of the Chairman of the Provincial People's Committee on strengthening management of activities of exploiting land for common construction materials in Soc Trang province.
10. The owner commits to prepare and submit the report to prove the completion of structures and environmental measures prior to the official operation of the plant.
11. The project owner commits not to use chemicals, microorganisms prohibited by the regulations of Vietnam and international conventions.

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